approach

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Dick Vranian

Flying in turbulence

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Recently, there has been a great deal of attention focused on the problems associated with flight in turbulent air. This has resulted from a number of reported incidents experienced by large jet transports where loss of control has occurred during flight in rough air. These incidents have brought about a reexamination of airplane characteristics at both high and low speeds, as well as a reevaluation of turbulence penetration speeds and techniques.

For many years, the major problems associated with flight in turbulence were considered to be physical discomfort and the ability to continue flight at a speed compatible with maximum airplane strength. Many tales have been related of aircraft ". . tossed like a leaf in a storm . ." yet very little definitive data were available. Gust intensity data were meager, and little or no knowledge existed with regard to the phenomenon of "clear air turbulence." The introduction of the commercial jet transport with its relatively high speed and altitude operating regime has accelerated the development of forecasting techniques, yet until quite recently, recognition of some of the problems associated with flight in this environment has lagged. A number of incidents, some serious, pointed out the need for a reevaluation of flight techniques, cockpit instrumentation and turbulent air penetration speeds.

Historically, turbulence has always been associated with visible phenomena such as thunderstorm or frontal activity, and flight over mountainous areas. Generally, the solution to flight in these conditions was to avoid the area if possible, and with the widespread use of weather radar, encounters of this nature can be held to a minimum. There are, of course, situations where the avoidance of turbulent areas is impossible, or impractical, and it is to these situations that this discussion is addressed.

Turbulence is experienced throughout the earth's atmosphere, over land and sea, and during night and day. During the last few years, NASA has obtained

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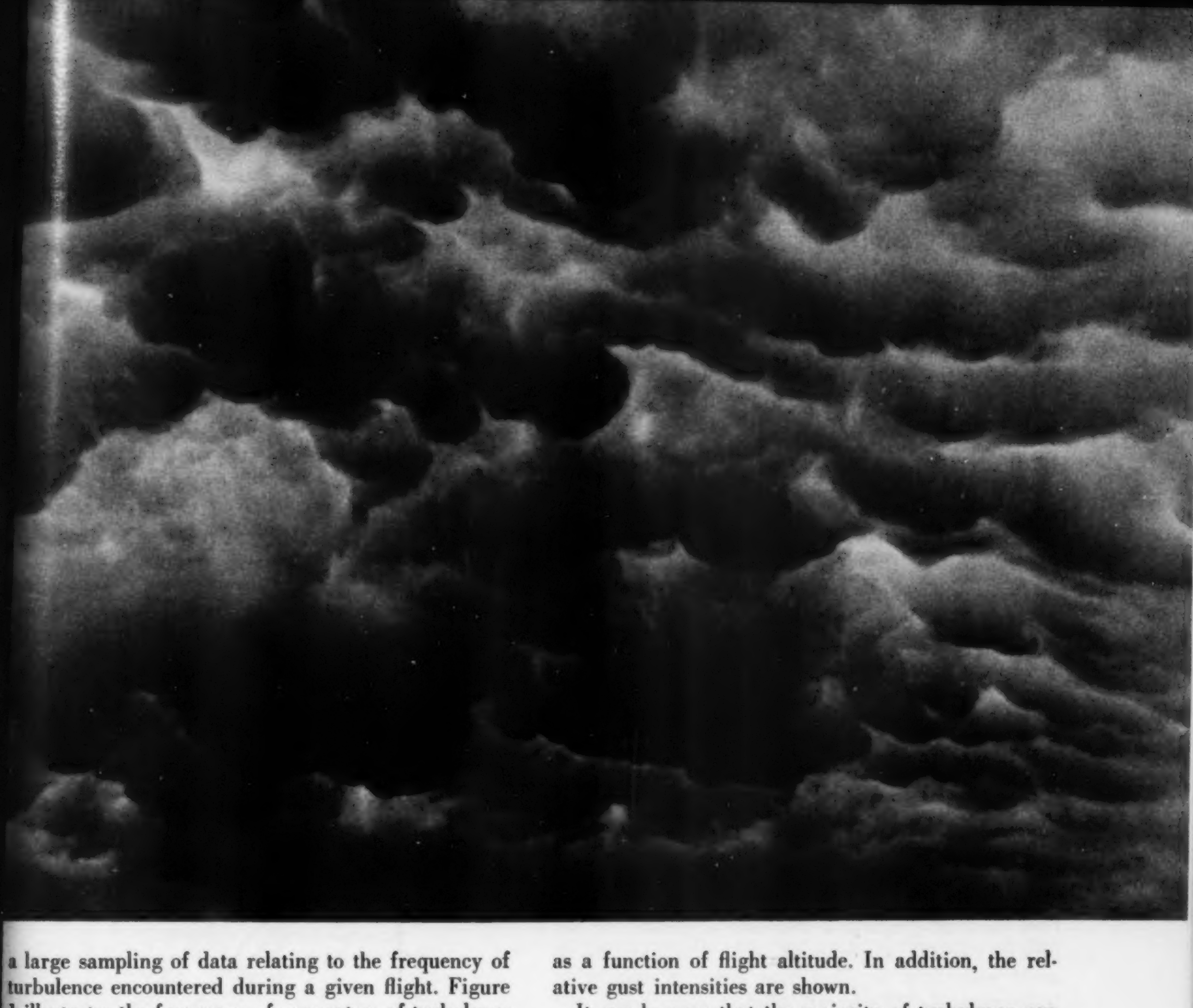


a large sampling of data relating to the frequency of turbulence encountered during a given flight. Figure 1 illustrates the frequency of encounters of turbulence as a function of flight altitude. In addition, the relative gust intensities are shown.

ATMOSPHERIC TURBULENCE

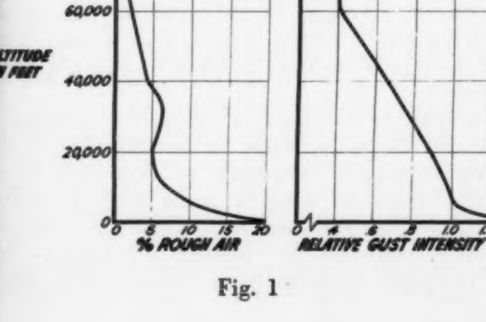


Fig. 1

It can be seen that the majority of turbulence can be expected to occur at the low altitudes. This is understandable since the very causes of turbulence, clouds and gusty winds, occupy this area of the atmosphere. The bulge in the curve at the higher altitudes accents the existence of clear air turbulence typical of the jet stream and mountain wave activity.

Performance Characteristics vs Design

There are certain performance characteristics of the airplane that have a direct bearing on the aircraft structural design, since they define the loads that the airplane must withstand.

If an airplane is in steady level flight, the wings must support a given load, and the airplane is said to be in 1-g flight. If the airplane is subjected to a pullup or a banked turn, the wings must support a

greater load. The ratio of this greater load to the airplane weight is called "load factor."

When the load factor is the result of a pullup, pushover, or turn, the resulting load factor is referred to as a "maneuvering load factor." The load factor becomes a measure of acceleration; thus, in a 3-g pullup the airplane experiences a load factor of 3, and an upward acceleration of 2g.

It is generally assumed that since the acceleration is the same for all parts of the airplane, all the structure is subjected to the same load. This is not precisely true, since if there is severe rotational acceleration, pitching, yawing, or rolling, the loads applied to various components from the motions will increase as a function of the distance from the airplane center of gravity. This, in its simplest terms, accounts for the rougher ride that passengers experience when seated aft in the airplane.

It can be seen that severe loads can be applied on all parts of the airplane during maneuvering. Some decisions must be made as to the severity of the anticipated maneuvers to which the airplane will be subjected and a limit load factor must be established. This is done during the early design of the airplane and is usually thoroughly specified in the airplane detail specification, military requirement, or applicable commercial airworthiness regulation.

The limit load factor will obviously be quite different for various aircraft series—high for fighters, where violent maneuvering may be required, and lowest for transport aircraft where deliberate maneuvers are rather mild. Once these limit load factors have been determined, it becomes necessary for the pilot to fly the airplane in such a manner as to avoid exceeding the limit load factor if damage is to be avoided. The aircraft designer often tailors the control system in such a manner as to make the achievement of the limit load factor physically difficult from the standpoint of pilot effort required on the controls to develop a given load factor.

Although the pilot can exercise precise control on the development of a given load factor due to a deliberate maneuver, there are some airplane accelerations that are, relatively speaking, not under the direct control of the pilot. These occur during flight in turbulence and are associated with gusts. These gusts are in turn associated with vertical and horizontal wind velocity gradients in the atmosphere.

The horizontal gusts produce a change in dynamic pressure on the airplane, but cause a relatively small change in the flight load factor. The major changes are due to vertical gusts, which effectively change the airplane angle of attack. Figure 2 shows the effect of a vertical gust on the developed load factor. It can be seen that the resultant combination

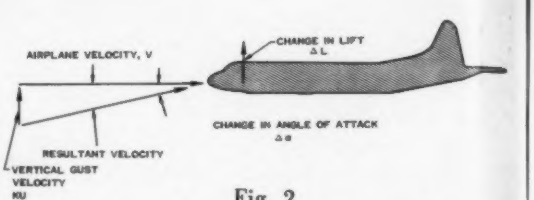


Fig. 2

of airplane velocity and vertical gust velocity causes a change in angle of attack, and consequently a change in lift and in the flight load factor.

Also, the gust load increment varies directly with the equivalent sharp-edged gust velocity, since this is directly related to change in angle of attack. In the design of an aircraft such as the P-3, response to gust is determined by the dynamic characteristics (see figure 3). The response is therefore dependent

CUMULATIVE DISTRIBUTION OF CLEAR AIR TURBULENCE GUSTS

OF GIVEN VELOCITIES ENCOUNTERED PER FLIGHT MILE AT VARIOUS ALTITUDES

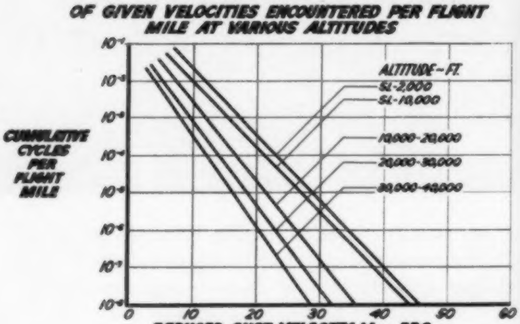


Fig. 3

on the gust wave length. Calculating the response of an airplane in turbulent air requires information pertaining to the gust disturbance which distinguishes between gust of various scale or wave lengths. This information is available in terms of power spectral density.

A complete description of atmospheric turbulence requires the measurement of the variance of the three rectangular components of air motion (horizontal component along the mean wind, horizontal component perpendicular to the mean wind, and the vertical component) as a function of frequency. This is the power spectrum. Some examples of problems

associated with atmospheric turbulence which are analyzed in this manner are: Tracking or bombing errors and passenger/crew comfort due to the flight path response of the airplane, and chordwise variations of the angle of attack on a wing in turbulent air. This entire subject is quite complex, and outside the scope of the present discussion. It has been mentioned only as an illustration of the thoroughness of modern aircraft design.

Research is presently being conducted on methods of applying the power spectrum approach to the determination of design loads in turbulence rather than using the discrete gust approach as described previously.

The properties of the airplane have a powerful influence on the gust load increment. The slope of the lift curve is a measure of the airplane's sensitivity to changes in angle of attack. Figure 4

LIFT COEFFICIENT vs ANGLE OF ATTACK

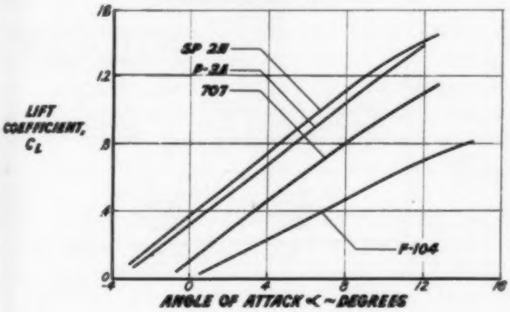


Fig. 4

shows a representative group of aircraft. It can be seen that a high aspect ratio straight wing has a high lift curve slope and therefore is quite sensitive to gust. Less sensitivity to gust is apparent for the low aspect ratio and swept wing aircraft.

Gross weight, or more properly wing loading (W/S), has a large apparent effect on gust load factors. If, for instance, a given vertical gust is encountered at a constant airplane speed, but with the same aircraft at two varying gross weights, the gust will appear to be stronger with the airplane at the lesser weight. This is because even though the combination of gust and forward velocities results in the same change of angle of attack, and thus lift, for both cases, the lift change acts on a lighter mass in the case of the light airplane and the resulting high accelerations and inertial forces tend to magnify the impression of the magnitude of the turbulence.

Since the pilot senses the degree of turbulence by accelerations and inertial forces, this is often misleading. The effect of increased or decreased airspeed is apparent by examination of the slope of the lift curve, related to passenger comfort by relating the data into a parameter of load factor/degree change in angle of attack. This is merely another manner of depicting the airplane's sensitivity to gusts.

Structural Aspects

The load factors that dictate the design strength of an airplane are summarized on a V-n diagram. The diagram illustrated (Figure 5) is applicable to

P-3A OPERATING FLIGHT ENVELOPE

V-n DIAGRAM 127,200 LB - FLAPS UP - GEAR UP

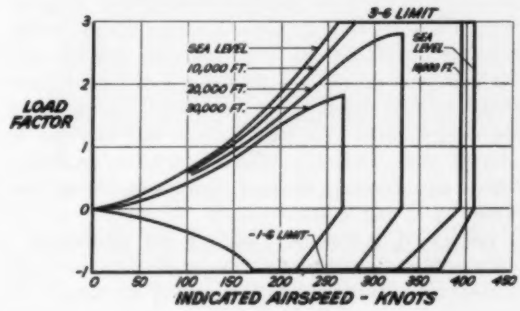


Fig. 5

the P-3 aircraft. The speeds and load factors shown are those specified in the detail specification of the airplane and are applicable only to symmetrical pull-up or pushover maneuvers. Figure 6 shows an example of permissible gust velocity as defined by

PERMISSIBLE P-3 AIRSPEED WITH GUST INTENSITY

127,200 LB - FLAPS UP - GEAR UP - SEA LEVEL

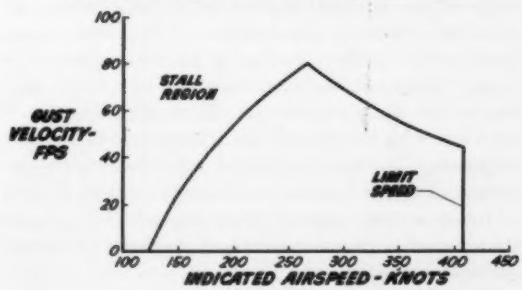


Fig. 6

the airplane strength diagram.

In reviewing the material, it can be seen that a limit positive load factor of 3g can be withstood at any speed with the range shown. A steady pullup can be made in smooth air at speeds from 254 kts at sea level below which accelerated stalling will occur, and 405 kts at sea level, the design dive speed. The effects of altitude are included and can be seen as limiting the available load factor that can be developed at high altitudes.

Operations at speeds in the area of the accelerated stall can impose high dynamic loads on the aircraft and should be avoided. Operation at speeds in excess of the design dive speed are apt to cause damage to the airplane structure by imposing high torsional loads on the wings, or by necessitating high balancing loads on the horizontal tail to offset the increased pitching tendency of the airplane. Other airplane components, landing gear doors, cooling flaps, bombbay doors, windshields, . . . (items affected by high dynamic pressures) are subjected to increased loads at the higher speeds. Flight at speeds in excess of the design speed can also subject the airplane to adverse compressibility effects, such as buffeting, where the control surfaces experience large unsymmetrical and unsteady loads.

Effect of Airplane Loading on Strength

In order to maintain adequate airplane strength during all operations, it is necessary to follow the instructions provided in the airplane flight manual with regard to loading. It is apparent that the maximum loads on the wing will occur when the airplane is operated at its maximum gross weight. Wing loads are highest when the airplane is carrying its maximum payload in combination with its maximum weight.

Fuselage loads, on the other hand, depend not only on the magnitude of the payload, but its distribution. Thus adherence to the recommended loading schedules is mandatory to avoid excessive structural loads. Where, as previously stated, the maximum wing loads occur in combination with the carrying of maximum payload, the addition of fuel has a profound effect on the actual wing loads experienced in flight. Figure 7 illustrates how the weight of fuel carried in the wing acts to relieve the wing bending caused by the airload. An illustration of this sort emphasizes the requirement of adherence to the recommended fuel loading and management as defined in the applicable airplane flight manual. The example shown applies to a contemporary four-engine cargo/transport airplane.

It can be seen that the change in wing bending resulting from consumption of fuel can be expressed

Fig. 7

in terms of permissible airplane load factor. Figure 8 shows the variation of permissible load factor as a function of gross weight and fuel remaining in the wing during a typical flight. The most critical

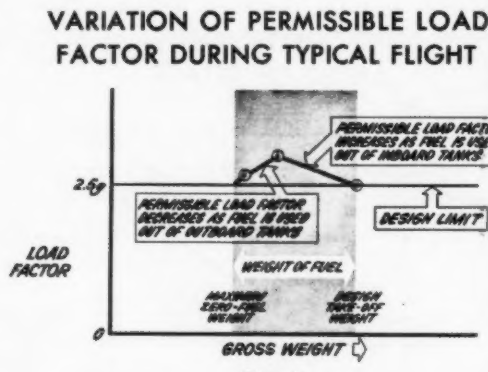


Fig. 8

combination of fuel and payload exists at the maximum takeoff weight.

At this weight, the airplane can be operated at the load factor specified in the basic V-n diagram. The effects of fuel management can now be shown. As fuel is used from the inboard tanks, the permissible load factor increases until it reaches a peak when the inboard tanks are empty. Beyond this point, fuel must be used from the outer tanks, resulting in a decrease in the actual permissible load factor until with all tanks empty, and the airplane at its maximum zero-fuel weight, it again can be operated in compliance with the V-n diagram. It can be seen that although the airplane is limited to a given load factor by its design and this is stated in the limitations section of the flight manual, fuel management procedures are developed which further increase the margin of safety to which the airplane is designed. It is not practical to specify these subtle changes in allowable load factors, but to retain them as factors

of operational conservatism.

The term "maximum zero-fuel weight" is often misunderstood, but is of sufficient importance that it should be reviewed. Simply stated, it is the maximum permissible gross weight of the airplane without any fuel on board. An illustration can best be used to show its importance. Consider the wing airload on an airplane in level flight at a given gross weight. The airload is supporting the airplane weight and is acting as a load applied to the wing.

An increase in gross weight results in a higher airload necessary to support the increased weight. If the added weight is in the form of fuel carried in the wing, the increased weight acts in a manner to relieve the added airload. If, on the other hand, the extra weight comes from adding payload within the fuselage (increasing the zero-fuel weight), none of the added weight acts to relieve the increased airload.

For this reason, the maximum zero-fuel weight is generally a design condition for some part of the wing, and exceeding the specified value will result in exceeding the design loads of the wing. Wing loads are materially affected by the amount and distribution of fuel, and are designed to a specific fuel management schedule. For this reason, the fuel management procedures specified in the airplane flight manuals should be used, since to deviate from these may result in reduced airplane capabilities during maneuvering flight or when flying in turbulence.

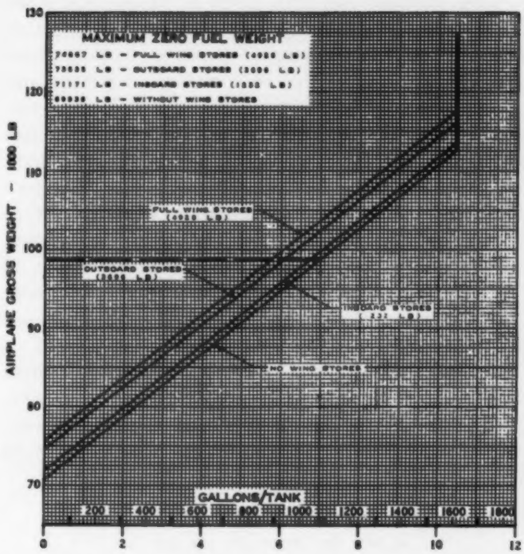
External stores, when carried on the wing, act in a similar manner to fuel carried within the wing, in that they tend to provide wing bending relief. Figure 9 illustrates the effects of various external stores on the allowable zero-fuel weight for the P-3 aircraft.

Turbulence Penetration Speeds

In early flying, weather was a major factor in flight planning. Most flights were conducted in or below weather. They were rarely smooth and often cancelled. As aviation progressed with faster, higher flying aircraft, flight stages became longer and often alternate routes could be selected to minimize the exposure to bad weather. Higher altitudes were attainable and areas of bad weather could be topped, and the increased wing loadings resulted in smoother rides when turbulence was encountered.

The concept of a recommended rough air penetration speed came into being at the end of World War II with the advent of the latest, for then, transport aircraft. These speeds were chosen to minimize structural risks associated with penetration into areas of severe turbulence. Coincidentally, much thunderstorm research was underway, and as knowledge increased, many of the earlier fears and legends about

MINIMUM FUEL FOR FLIGHT



NOTE: 1. These quantities based on unit fuel weight of 6.5 lb per gallon
2. Quantity of fuel shown is for outboard tanks only
3. For wing store weights other than indicated use line for "no wing stores" raised by the total weight of wing stores.

FUEL PER TANK 1 OR 4 – 1000 LB

Fig. 9

thunderstorm activity were dispelled. However, they still command respect (and avoidance).

There are two major concerns that a pilot faces when the necessity for operating in severe turbulence arises. One is the imposition of excessive structural loads on the aircraft, while the other is that the airplane attitude many reach undesirable extremes. Both of these justify concern. However, the classic treatment of turbulence penetration has tended to place too much emphasis on the structural aspect. You are aware that flight at a high speed through a given gust will produce a rougher ride and higher load factors than would be experienced if the turbulence were penetrated at a more moderate speed.

The long standing admonition to slow down to the rough air penetration speed of the past when encountering turbulence has reinforced this argument. This concept had a valid basis for its general acceptance. Engineering methods for determining the effects of turbulence on structural loads are well known, and as a result, the classic discussion of the rough air penetration problem has tended to focus on such calculations and place the emphasis on the

structural significance of high speed entry into rough air.

Less attention has been given to the more obscure prediction of the (sometimes) extreme attitudes that could result from attempted flight in turbulence at too low a speed. There is a strong suspicion, and some direct evidence, that almost every structural breakup that has occurred in extreme turbulence has been preceded by a severe change in attitude, with the breakup being brought about by the attempted recovery maneuver in combination with the severe turbulence. For this reason, the simple calculation of the minimum safe speed, to avoid the region of the accelerated stall with the imposition of a given gust experienced in straight and level flight, may not be representative of the real problem.

In fact, magnitude of the speed margin provided above the aforementioned minimum speed has come to the front for defining operating speeds in severe turbulence. Figure 10 shows the available flight

P-3A BUFFET BOUNDARY

FLAPS UP - GEAR UP - 110,000 LBS.

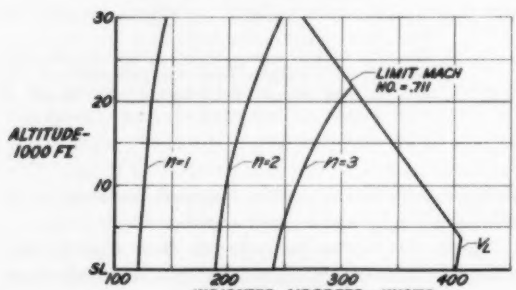


Fig. 10

envelope for a typical airplane (P-3) as a function of altitude and defines the area of low speed buffet as well as the maximum dive speed. The left hand curves define the low-speed buffet boundary—reduce speed to this point, and pre-stall buffet begins. To the left of this line, the airplane will be at, or near, the point where lift is lost. Even more important, it will be in an area where loss of control is quite probable in turbulence.

Note that this speed increases as altitude is increased. On aircraft such as the P-3, there is no high speed buffet boundary evident at speeds up to, and including, the maximum dive speed, so these speeds are of no concern in this discussion.

Gross weight has a drastic effect on the buffet boundary, lowering the boundary as weight increases. An increase in load factor, whether by maneuvering or by encountering turbulence, has the same effect as increasing the gross weight. The dashed lines indicate the buffet boundary that would exist with excess load factor due either to maneuvering or turbulence.

It can be seen that two important items must be considered in the determination of a turbulence penetration speed. The chosen speed must be high enough to protect against a gust-induced stall, yet low enough to protect the airplane against the imposition of excessive structural loads. In the past, the tendency has been to select the turbulence penetration speed well below that which, with a gust encounter, could lead to structural damage to the airframe. There is no doubt that flight at relatively low speeds in moderate turbulence is completely satisfactory, and will provide a smoother ride, but there are several disadvantages which must be considered in the event of severe turbulence.

First, the airplane is operating significantly closer to the stall buffet area and since the angle of attack changes caused by severe turbulence can be high, there is a greater chance of encountering buffeting and the accompanying high drag that will cause loss of altitude and tempt the pilot to make undesirable thrust changes. Trim changes due to thrust changes are higher in the low speed regions because the aircraft is flying on the backside of the power required curve at low speeds. Second, airplane lateral and directional control is less effective, and finally, control is more difficult since trim changes due to airplane speed changes are greater in the low speed region than when operating at higher speeds.

Aircraft structural criteria and turbulence penetration speeds can be determined with the available gust and turbulence information, but it is quite difficult to relate the severity of turbulence encountered because of the widely varying pilot reports received. The following information is extracted from the NACA guide for reporting turbulence and has been used as an aid in standardization of turbulence reporting.

Operational Techniques

Although recommendations are made for flight in turbulent air, in the final analysis the judgment of the pilot provides the overriding influence in the operation of the airplane. The information discussed in this section is not meant to be a set of specific instructions or recommendations, but is supplied as material for consideration in the determination of operating procedures and techniques to be used in turbulent air.

Effective and Derived Vertical Gust Velocities for current transport aircraft

Turbulence	Definition	Airspeed Fluctuation	Ue (the order of)	Ude (the order of)
Light	A turbulent condition during which occupants may be required to use seat belts, but objects in the airplane remain at rest.	5 to 15 kts	5 fps	8 fps
Moderate	A turbulent condition in which occupants require seat belts and occasionally are thrown against the belt. Unsecured objects in the airplane move about.	15 to 25 kts	15 fps	24 fps
Severe	A turbulent condition in which the airplane momentarily may be out of control. Occupants are thrown violently against the belt and back into the seat. Objects not secured in the aircraft are tossed about.	More than 25 kts	25 fps	40 fps
Extreme	A rarely encountered turbulent condition in which the aircraft is violently tossed about, and is practically impossible to control. May cause structural damage.	Rapid fluctuations in excess of 25 kts	30 fps and above	48 fps and above

Obviously, it is fundamental to be well prepared in advance for an encounter with turbulence. If sufficient warning is available the airplane should be flown at the recommended speed, with the power adjusted, and the airplane trimmed for level flight. Seat belts and shoulder harnesses should be fastened. If the encounter is unexpected, the trim and power should be adjusted in such a manner that there is no rapid deceleration with a resultant out-of-trim condition, since it is felt that it is better to be slightly fast rather than significantly out of trim. Speed should be reduced in an orderly manner.

There has been a great deal of controversy with regard to the procedures to be used to achieve the optimum flight control in rough air. It is felt that the best advice is to concentrate on airplane attitude, and ride out the changes in speed and altitude. The natural stability of the airplane will tend to minimize the loads imposed by turbulence, and overcontrolling should be avoided. Elevator control inputs should be minimized. However, wings-level flight should be maintained by use of whatever aileron control that may be required.

The basic airplane stability often leads to a confusing situation when encountering a strong sustained draft. In a sustained downdraft, for example, the airplane will initially pitch nose-up, yet the altitude will decrease. The natural stability of the airplane will manifest itself in a long-period (phugoid) oscillation in the pitch axis unless the motion thus started is controlled. This oscillation is easy to overcome. However, since the magnitude and direction of the next gust is unknown, it is often best to allow some excursion in pitch attitude rather than to try to control it precisely. In any event, the suggested elevator control applications will not permit precise pitch control. Essentially, the optimum technique tends to permit the airplane to follow a mean flight path.

The airplane will tend to return to stable trimmed flight as soon as the disturbance that caused the deviation is eliminated. This return to stable flight will have commenced before the pilot will have recognized the departure, discriminated, and acted. It then becomes highly possible that the pilot's control input will merely reinforce the airplane's tendency to return to the original condition and provide

sufficient power that the airplane overshoots the required attitude. This results in an oscillation about the desired flight path.

For this reason, control inputs in the pitch axis should be smooth and moderate. The reaction time of the pilot tends to provide a certain amount of damping, and although the attitude may vary somewhat, the vertical loads applied to the airplane will tend to be reduced over those that would be applied if rigorous flight path control were possible. A suggested flight technique is to apply elevator control smoothly in a direction to resist motions away from the desired attitude, and remove the control input as soon as the airplane begins progressing toward the desired attitude.

Human Pilot vs The Autopilot

The above discussion is limited to the human pilot, but let's consider the function of the autopilot in this situation. There is no set rule for operation with the autopilot on or off in turbulent air, but there are some considerations that should be weighed in regard to the final decision as to its use in rough air. Quite obviously since there are a number of airplane/autopilot combinations, each type should be considered separately. Let's consider some of the arguments.

The autopilot is better off than the human pilot because it does not rely on the ability to read and interpret instruments prior to application of corrective control. True. It is not bothered by shaking instrument panels. True. It is not easily distracted by lightning or hail pounding on the airplane. True, so far. There has been some concern exhibited that the autopilot, by virtue of its rigorous pitch axis control, will add to the effects of gusts and thereby increase the structural loads to the airplane. True—at least to an extent.

There is no doubt that the autopilot control can couple with a gust and increase the airplane load factor, but so can an input from the human pilot. Moderate, gentle control inputs are desirable from the human pilot, but the autopilot control inputs are also limited. Either the autopilot or human pilot can add to the gust load factor, but neither can be considered more apt to do so. Remember, also, the autopilot is "force-limited," while the human is not.

If the autopilot is used in turbulence, it is important to monitor the pitch trim. If the airplane experiences a sustained up or downdraft, the pitch attitude will change. The autopilot will resist the change with the application of elevator trim. If this application persists, it is possible for the airplane to be significantly out of trim when a draft in the opposite direction is encountered. Obviously since the rate of autopilot trim application is very low, it is easy to monitor the trim to prevent excessive trim application.

Disengagement of the autopilot at an inappropriate time is considered to be a problem, but not any more so than the failure of a number of equally important airplane components that we rely on during all flight regimes. If the autopilot is provided with a limited rate of control, and will not abruptly disengage without warning, it can probably do a pretty good job for the pilot since it is not easily distracted and need not rely on instrument reading and interpretation for its actions.

This all leads to the conclusion that there is little doubt that the use of the autopilot in moderate or less turbulence is desirable. It also appears that continued use of the autopilot is acceptable in greater turbulence provided its limitations are known and understood, and its operation is monitored. It appears neither necessary nor desirable that the autopilot be turned off in turbulence, since it can provide greater control than would be possible if it were not used. Finally, use of the autopilot frees the pilot to more adequately monitor the operation of the airplane, which alone is an important safety factor.

At the present time, there is insufficient evidence available to adequately define the desirability of using the altitude hold function of the autopilot in turbulence, so for the time being it is probably best to leave it off.

A summary of some of the recommended procedures for flight in turbulent air would contain:

- Avoid turbulent areas if possible.
- If the area must be entered, prepare the aircraft and crew beforehand. Fasten seatbelts and shoulder harnesses and secure any loose articles.
- Enter the turbulence using the recommended penetration speeds contained in the applicable airplane flight manual.
- Keep the wings level and use smooth, moderate elevator control to maintain the pitch attitude.
- Don't chase airspeed. Severe turbulence will cause large and rapid variations in airspeed.
- Don't chase altitude. Sacrifice altitude (within reason) to maintain airspeed and attitude.
- Don't change power—except in the case of extreme continued airspeed variation.
- If the autopilot is being used, monitor attitude, airspeed and altitude, in that order of importance. In addition, monitor elevator trim and be alert for an inadvertent autopilot disconnect.

Maneuvering at weather minimums

Would you drive a car without a spare tire? Not likely. In spite of high tire reliability, a spare is insurance against the possibility, however remote, of a flat. For the pilot, a maneuver called "circling approach" is like a spare tire—though seldom required in this age of radar, you must still be prepared to use it.

The circling approach situation in its worst form develops during an instrument approach. It may be that a straight-in landing is impossible because of extremely high winds, obstructions on the runway, etc., so your clearance for approach will have an additional instruction: "Circle to land on runway (number)." This means that after breaking out into visual conditions you will have to maneuver at low altitude to line up with the duty runway.

A procedure for the military pilot, published as far back as 1943, has been the "low-visibility approach." After breaking out, turn to "fly downwind directly over the landing runway, and as the end of the runway is passed, make either a 40-second or a 90-degree type of procedure turn . . ." (see Figure 1).

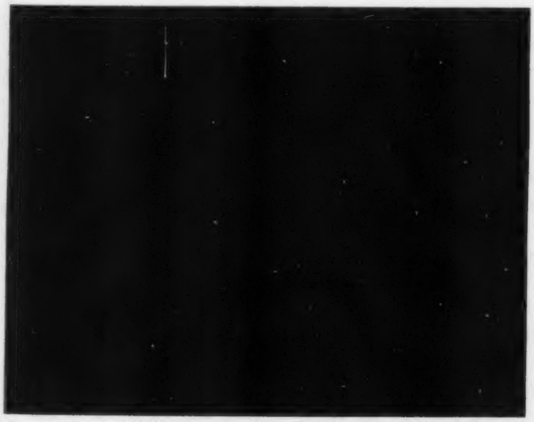


Fig. 1. Low visibility approaches, (top) 40-second, 45-degree method (bottom) 90-270 degree method.

This low-visibility procedure is not, by strict interpretation, the circling approach procedure. Figure 2 shows a landing made on a heading 180 degrees from the approach course. As the runway is sighted on the approach, a turn is made to establish a downwind leg to keep the runway in sight.

Each method accomplishes the same ultimate objective but there is one significant difference. While the low-visibility type stresses a continuation of instrument flight, the circling approach stresses the visual aspects; maneuvering to keep the airplane within sight of the runway.

There are several other factors which give the

Fig. 2. Close-in contact circling approach.

circling approach an advantage over the low-viz type. In certain situations the circling approach consumes less time from breakout to touchdown. Then, if you are taking off in IFR conditions and there is a sudden need to return for landing, the circling technique can be used to stay below the overcast and make a close-in contact approach (this assumes that "circling" minimums exist).

On the approach plate the minimum ceiling listed for a circling approach gives you 300 ft of obstacle clearance within 1.7 nautical miles (2 statute miles) of the airfield boundary. Basic circling minimums are considered to be 500 ft and one (statute) mile visibility; however, 60 percent of the USN/USMC airfields in the Continental U. S. have ceiling minimums higher than 500 ft due to terrain features or obstructions within the area.

Any discussion of maneuvering at weather mini-

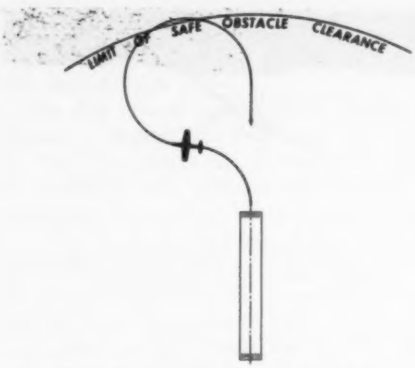


Fig. 3. At 100 kts 16 degrees angle of bank is required for a 3-degree per second rate of turn. Radius of turn is 3500 ft and total distance from end of runway is 10,500 ft.

mums must include angle of bank, radius of turn, and speed. When these factors are discussed in terms of modern traffic pattern speeds a weakness in the low-visibility procedure becomes evident.

As an example, assume an approach to runway 36 requires maneuvering to land on runway 18. Weather is 500 ft and one mile.

Figure 3 shows that even for 100 kts, and using a bank angle giving a turn of 3-degrees per second, the aircraft will be at the edge of the safe obstacle clearance when a 90-270 turn is used. In Figure 4, using the same speed and rate of turn conditions, the 45-degree, 40-second procedure will put the aircraft outside the safe obstacle clearance area.

It would be possible to steepen the bank angle and reduce the radius of turn but even then much of the maneuvering would be beyond visual sight of the runway and the increased rate of turn would not be

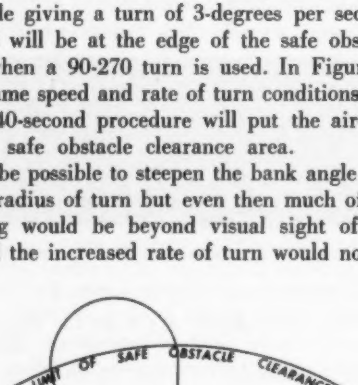


Fig. 4. At 100 kts and turning at 3-degrees per second, total distance from end of runway is 13,300 ft.

consistent with traditional instrument flying concepts.

If we could maintain visual contact with the runway things would be different. Bank angles up to 30 degrees could be safely used and the radius of turn would be greatly reduced. At 130 kts and 30 degrees bank the radius of turn is 2600 ft (5200-foot diameter) which can keep the aircraft within visibility minimums of one mile. Figure 5 is based on the same scale as figures 3 and 4 and shows the reduced maneuvering area required for 130 kts and 30 degrees bank.

Getting into position on downwind for a landing on a heading 180 degrees from the approach course can be done as follows: after becoming visual and with the runway clearly in sight, turn 45 degrees off the downwind heading (30-degree bank) and hold this heading for 20 seconds. Then turn to the downwind heading (30-degree bank).

If you are ever called upon to shoot a circling approach, there is a 50 percent chance that it will

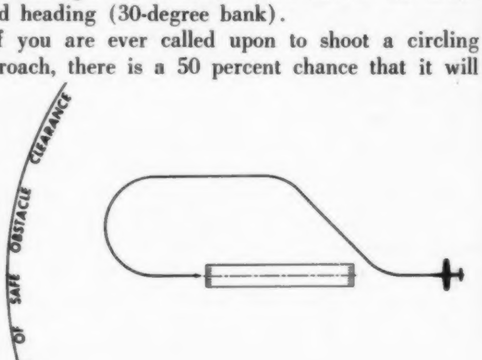


Fig. 5. Increasing speed to 130 kts and using 30 degrees of bank radius of turn is 2600 ft. Total distance from end of runway is 5200 ft.

be the situation which has just been discussed; landing 180 from the approach course. Slightly over 50 percent of the military fields in the Continental U. S. do not have cross runways and there are only two possible landing directions. (20 percent for USN/USMC airfields)

Where the field has cross runways a circling approach situation can occur with the landing runway perpendicular to the instrument approach course. For example, the inbound heading is 360 and you are to circle and land on runway 27. Upon breakout to visual conditions there may be an opportunity to turn downwind (heading 090) before reaching the runway.

However, if things are not going smoothly, don't turn short of the runway. Continue on across the landing runway at right angles and make a timed precision maneuver out of the situation. Fly for 10

to 12 seconds beyond the landing runway then commence a 30-degree bank turn to downwind heading. The approach speed will determine the timing to begin the downwind turn but 12 seconds at 130 kts will hold the distance abeam the runway to the visibility limit of one mile.

When turning to downwind short of the runway the greatest hazard is turning late with consequent overshooting the turn to final. Several airline accidents have been caused by this. In one case the pilot was making an ADF approach when he turned downwind short of the field, but too close in. As a result he overshot his turn to final, racked it up into a near vertical bank and crashed $\frac{1}{4}$ mile from the end of the runway. In a similar case, the pilot of a four-engine turboprop entered an over-the-top spin from a low altitude steep bank after coming off a VOR approach with a turn to downwind short of the field. Figure 6 shows the preferential and alternate method.

The sort of weather in which you may have to make a close-in, low altitude approach is generally windy and wet, and possibly compounded by darkness, therefore, whenever possible try to bring an element of planning and timing into the problem. In a fatal C-54 accident the pilot was not prepared for the need to circle for his landing. Altitude was lost after becoming visual and when a turn was commenced it was in the wrong direction. Further loss of altitude put the aircraft into the ground inside the field boundary.

Figure 7 shows various other situations which may call for maneuvering at low altitude. The methods are suggestions and the selection of the pattern required to accomplish a safe landing rests with the pilot.

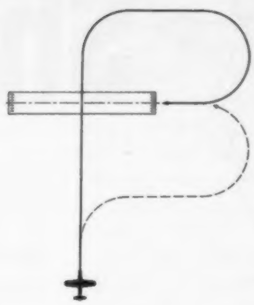


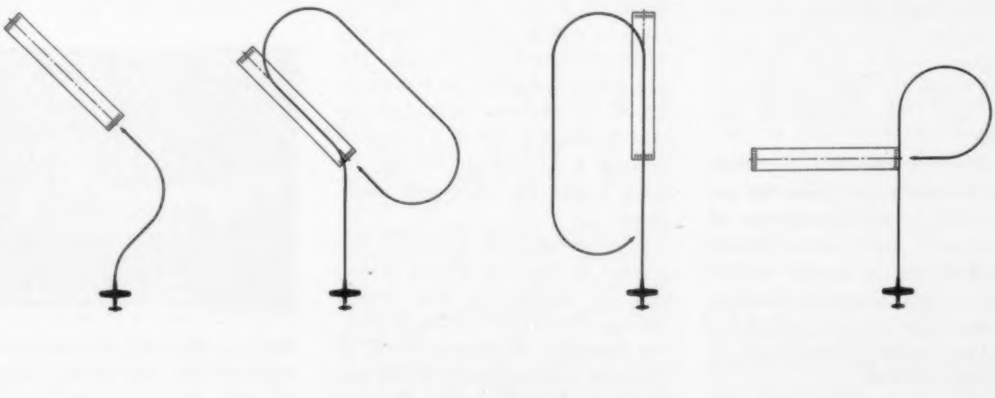
Fig. 6. Solid line shows preferential method when landing will be made at right angle to approach course. Dashed line is alternate.

Approach speed has a direct relationship to turning radius whenever a specific angle of bank is involved. At 150 kts, to remain in visual contact with the runway using 30 degrees of bank, visibility should be at least $1\frac{1}{2}$ miles. If there is any doubt whether the aircraft can be safely maneuvered to the point of touchdown, execute a missed approach.

Pensacola alumni should have no trouble maneuvering at ceiling minimums for a circling approach: FMLP is often conducted under a 500-ft ceiling and ASW training is primarily devoted to low-altitude precision flying. But in aviation, the unexpected is to be expected. Add to that, what has not been practiced, does not always come off well.

As a training maneuver, the circling approach polishes up speed and bank control while requiring precise altitude control. More important, it prepares you for the unexpected.

Fig. 7. (A) Runway sighted in time to set up base leg. **(B) Runway sighted too late for a base leg turn.** **(C) Too high for straight-in or late sighting of runway.** **(D) Approach course crosses landing runway near threshold.**



Short Snorts

Distractions and failure to observe instrument minimums can trap the unwary.

Night Target Identification

After being vectored toward an unidentified radar contact by an E-1, the *Tracker* crew acquired the target on its own weapon and continued inbound. Although flight visibility was 10 miles, conditions were exceptionally dark near the surface because of a broken-to-overcast ceiling at 1000 ft. It was early morning and the moon had previously set.

At five miles, visual contact was established and the pilot began a descent from 800 ft. Since normal searchlight procedures could not be utilized due to exercise restrictions, he was planning to make a visual identification first, to determine if the ship was of the type that could be legally illuminated.

Only one white light was showing on the target and the pilot altered his run-in heading as necessary to allow the copilot to maintain visual contact. As the *Tracker* passed abeam the light, a thud was heard and felt throughout the aircraft.

During the climbout the pilot found he could not raise the radome. After a satisfactory test of the aircraft's flight characteristics at altitude he proceeded to the beach for an uneventful landing. Damage to the aircraft included a stoved-up radar pedestal and a demolished radome.

The inadvertent loss of altitude during the final run-in on the target was a result of the pilot using partial VFR/IFR procedures. Altimeter errors were not a factor. Adherence to strict instrument procedures would have prevented this mishap.

Jumped Chocks

While the pilot of an A-3 was making a full power check prior to leaving the line for a test flight, the aircraft jumped the chocks.

The pilot immediately reduced power to idle and applied his brakes, but the latter were ineffective. Using nosewheel steering he managed to maneuver around obstacles in his immediate path and then rode the aircraft straight ahead for another 500 ft before it came to a stop with the nose and starboard wheels in soft soil. The port wheel remained on the shoulder of the parking ramp. Just before it stopped, the A-3 ploughed through a 4-foot-high wooden slat litter fence. The pilot was uninjured.

A deviation from NATOPS was evident in that the Hytrol system was ON during the high power run-up. With Hytrol ON and working properly, the brakes would be released, intermittently, as the system sensed the tendency of a wheel to skid. This condition could reduce the effectiveness of the chocks, since the wheels could gain a slight rolling momentum before coming into contact with them.

After jumping the chocks and realizing his brakes were ineffective or at least intermittent, the pilot made a second mistake in not turning the Hytrol OFF and activating the emergency air brake.

Intermittent operation of the Hytrol system was caused by dirty contact points in the Skid Control box electrical relay.

How Did It Happen?

While on the downwind leg during a night practice GCA to runway 19R, the controller's transmissions started break-

ing up. Enough information was received by the pilot, however,

to get established on the base leg (heading 280 at 1700 ft) before communications broke down completely.

After a minute had elapsed without further instructions, the pilot added power, raised his gear and turned toward the tacan station (heading 210) in compliance with his lost communication procedures.

While in the turn the controller's voice boomed in loud and clear, informing the pilot that he was well above glide path and instructing him to begin a 1000-feet-per-minute descent. The pilot complied.

Except for starting above the glide path slope (1700 ft msl at four miles vice desired 1200 ft msl), the rest of the approach was normal. Communications were good and the pilot followed all instructions on final except one . . . that of checking his gear down and locked. Later, the pilot stated he did not recall receiving a gear-check instruction on final, but it was on the GCA tape.

The aircraft landed 2180 ft down the runway and slid to a stop in 2000 ft. The crew exited without injury. A small amount of residual fuel from the ruptured port and centerline drop tanks flared up briefly, but the fire was easily extinguished by the crash crews.

The circumstances involved here were typical of those connected with many inadvertent gear-up landing accidents. A break in the pilot's normal train of thought (Habit Pattern Interruption) occurred when a waveoff became necessary on the base leg as a result of lost communications. Then, after the pilot involved himself in a new course of action, he quickly returned to his former objective, upon renewal of communications, without insuring that the aircraft configuration was compatible with his decision to continue the approach.

Since Habit Pattern Interruptions may occur at any time during an approach, how should a pilot respond to them?

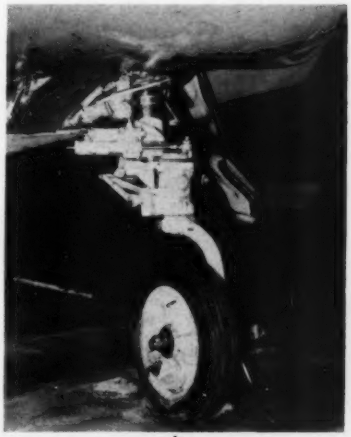
A lot depends on how much time the interruption has consumed.

If a pilot feels he has sufficient time to reestablish his train of thought, and review the landing checklist to insure that nothing has changed or been overlooked during the interruption, then he may reasonably decide to continue the approach.

If the interruption has left him feeling rushed or under pressure, however, and he doesn't feel that sufficient time remains to mentally put himself back in phase with the approach, then a waveoff would be the correct response.

In the final analysis, *there is no substitute for using the landing checklist during an approach.*

What's WRONG Here?



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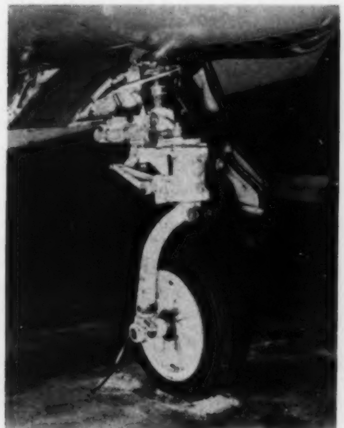


2

After taxiing forward out of the chocks the T-28 pilot attempted a left turn but the aircraft wouldn't cooperate. It wouldn't turn right either, so after 50 ft of forward travel he gave it up and shut down.

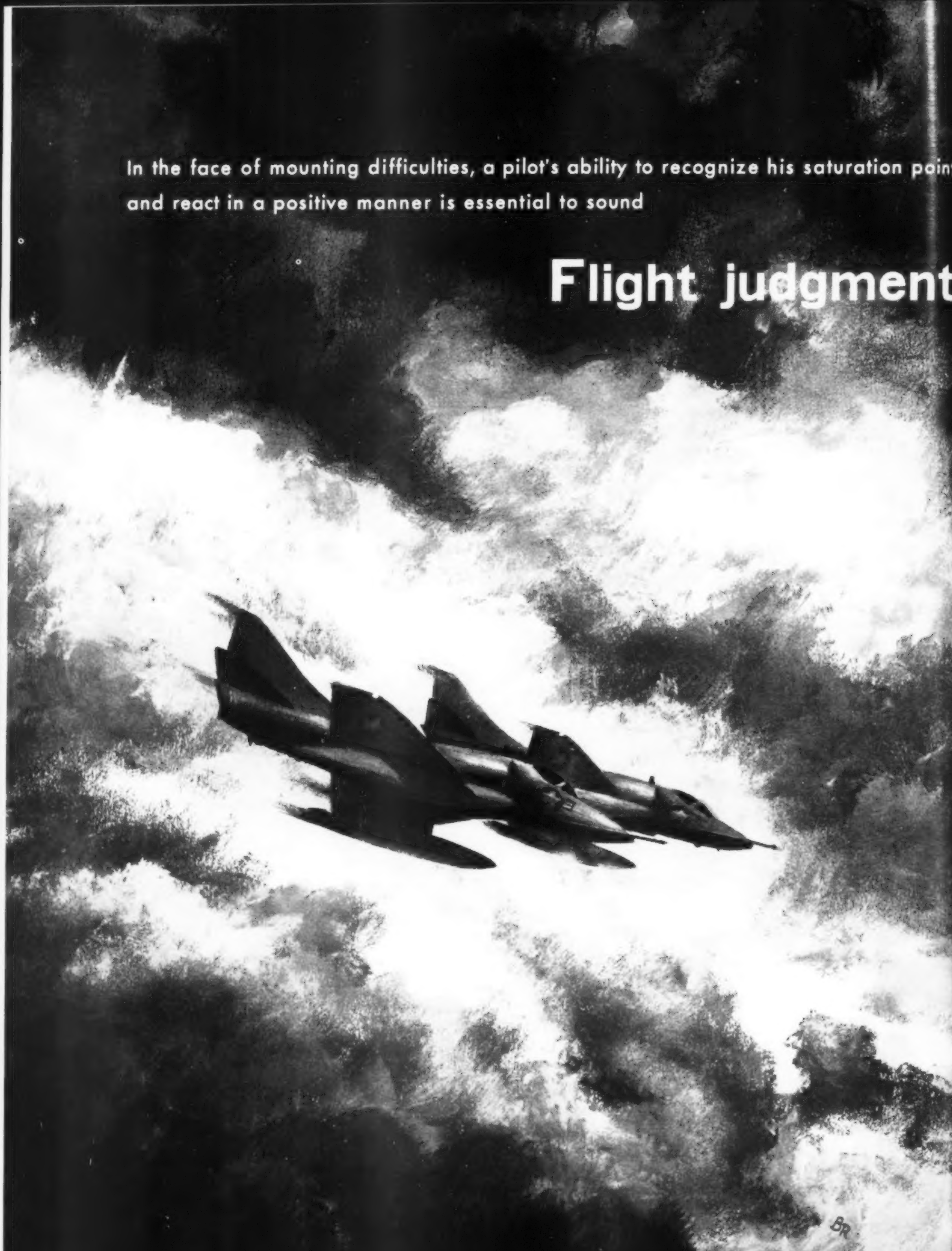
Inspection revealed that the nosewheel was swiveled 180 degrees (Photo 1) and was actually pointing backwards. The plane captain, student pilot and instructor pilot had overlooked this discrepancy during their individual preflights.

Apparently it's fairly easy to overlook such a discrepancy on the T-28, the main differences in appearance being that the nosewheel strut is on the port rather than the starboard side, and the two small towing eyelets are now behind the nosewheel shank. Also, the shimmy damper may be extended farther to the side of the nosewheel than normal. Photo 2 shows how the nosewheel should look during preflight.

This aircraft had recently been towed from the hangar, utilizing an axle-type towbar, and had been pushed backward into its parking spot on the line.

In the face of mounting difficulties, a pilot's ability to recognize his saturation point and react in a positive manner is essential to sound

Flight judgment

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"Navy 345 descend and maintain flight level two four zero." This routine transmission signaled the beginning of a chain of events that at times would seem stranger than fiction.

That morning the squadron operations officer had recommended the cancellation of the published flight schedule, since unsuitable weather conditions in the local operating area were not expected to improve during the day. As a substitute measure, he suggested that individual airways training flights be launched.

The skipper concurred and put the plan into action. Two pilots who were deficient in instrument time were instructed to plan individual flights to an air station about 500 miles away and then report to the operations officer for a briefing.

During his brief the ops officer instructed the pilots not to return to the home field (NAS Rainbow) if the weather deteriorated to or was forecast to be below OpNav minimums and in no case were they to return if the visibility was less than one mile. NAS Palm Tree, about 100 miles south of Rainbow, was suggested as an alternate for the return flight, since it was forecast to remain VFR throughout the day. In closing he emphasized that the return flights were not to be pressed into marginal weather. The pilots acknowledged their instructions without question.

After individual launches at 1345 and 1351 they proceeded to the destination without incident. The first to arrive completed one practice GCA before landing at 1530 while the second landed 20 minutes later after two practice GCAs.

Both pilots received a thorough brief from the Ops Officer before departure.

While the aircraft were being serviced the pilots made plans for the return flight. Since one of the aircraft had a weak/unreliable IFF, they decided to fly the enroute portion in formation and then make individual letdowns from over the published destination fix south of Rainbow.

At 1620 the pilots were in Meteorology having the weather filled in on their DD 175. Rainbow was reporting 500 overcast and 1½ miles visibility in rain and fog. Forecast weather at their ETA was 600 broken, 2500 overcast, 1 to 3 miles visibility in rain and fog, occasionally lowering to 500 overcast and ½-mile visibility in rain and fog. Palm Tree, the proposed alternate, was VFR and forecasted to remain so.

After completing his brief the Meteorologist overheard the following conversation between the pilots. "Let's don't go," said one, who was later identified as the wingman, "it looks a little too hairy!" "No sweat," replied the other. "If Rainbow weather is down we can use Palm Tree!" Both pilots then left Meteorology to file the DD 175.

The flight was airborne at 1759. Twenty minutes later it had reached the assigned flight level of 330.

Lead obtained permission to leave Center frequency at 1829 to check Rainbow weather. It was reporting a measured 500-foot overcast with 2 miles visibility in rain and fog and forecasting 800 overcast with visibility remaining at 2 miles.

Initial contact with the Center controlling IFR traffic into Rainbow was made at 1840. At that time Lead indicated that he desired a radar letdown, and asked the controller to "contact ahead" for the current weather, stating that he needed minimums of "three hundred and one."

At 1850 Center asked Lead if he wanted an enroute letdown or a penetration to Rainbow from the published fix south of the field. The flight leader replied that he wanted "an enroute descent with individual handling." This was a deviation from his original intention to proceed to the fix south of Rainbow before commencing a letdown, and it was a turning point in an otherwise well executed flight. By accepting a random section letdown in the clouds at night and abandoning a course of action which was familiar to both pilots, the flight leader siphoned away some of his margin of safety.

Admittedly, few flights are executed exactly as planned. We learn from experience to allow a safe flight margin for our own errors and the shortcomings of others. The ability to determine when that safe margin has or is about to be exceeded is the essence of good flight judgment. In this case it

would have dictated adhering to the original plan as long as it remained sound, and adopting a second course of action only if the first became unsound.

These pilots were not strangers to section letdowns at night in the clouds. They had experienced the very demanding airmanship required in this procedure during a recent deployment. Three months had passed since then, however, and perhaps they did not recall all of the intricacies involved. The section leader is burdened with the task of having to think and talk for two while flying with all-possible smoothness so as not

In response to Center's query, Lead asked for an enroute letdown.

to embarrass his wingman. He must anticipate changes of configuration soon enough to alert the wingman with light or radio signals. On the other hand the wingman is hard pressed just to maintain formation on the leader. He has little time to navigate and monitor his own instruments, let alone to divert his attention to his cockpit console while dialing in manual frequency changes and new IFF/SIF codes.

But let's get back to the story.

At 1853 Lead filed a flight plan to the alternate with Center "in the event of a missed approach." He requested 5000 ft enroute.

At 1856 Center asked Lead (Navy 345) how far out he would like to begin the enroute descent. "About fifty miles," he replied, indicating a preference for a comfortable descent "without using speed brakes going through this soup."

Ten minutes later the flight was cleared to descend to FL 240. At the time it was 55 miles west of Rainbow. Easing power, Lead pushed over and started down with the wingman tucked in on his right. One important matter had been overlooked or forgotten—current destination weather. Requested, true, but not yet received when the descent began. Lead whittled away his margin a little more at this point.

During the initial part of the descent some confusion existed between Center and Navy 345 as to the separation of the wingman (Navy 789) for individual penetrations. At last Center responded to the flight leader's repeated requests for separate penetrations by giving 789 a code to squawk and a heading of 180. This occurred at 1912 as the flight was passing FL 240 in compliance with a further clearance to descend to 5000 ft.

Navy 789 accepted the code but elected to remain with the flight leader until he was assured that Center could paint him, explaining that he had experienced previous trouble with his IFF. Meanwhile the flight continued its descent toward Rainbow.

At 1913, while passing FL 180, the wingman declared that he had vertigo and "would stick around" with Navy 345. A clear confession of vertigo! Surely this would evoke an appropriate response from Lead. There were several possibilities. He could level off, establish the wingman on his gages and then pass the lead. Better yet, he could break off the penetration and proceed to the VFR alternate. Failing selection of one of those more constructive measures, a simple inquiry as to "how he was doing" might have helped. But there was no response from Lead and the margin was reduced still further.

Without speed brakes the rate of descent was proving to be too slow—significantly less than the standard 4000-fpm letdown. At 1914, one minute after the wingman's confession to vertigo, Lead called him saying "let's go idle now." Still no speed brakes!

An idle, clean descent in the clouds may be enough to strike terror in the heart of any wingman. Even with full cockpit heat, the windshield and canopy will probably fog up, and at idle the wingman has no margin should he begin to overrun the leader. Add to these possibilities a thriving case of vertigo and the wingman's situation began to look grim.

At 1915 a frequency change was necessary when Center turned the flight over to Rainbow Approach Control. The wingman either missed this frequency change or was unable to make it (not a pre-set channel) and subsequently became a NORDO.

Thirty seconds later lead reported overhead Rainbow at "angels 14" and was directed to turn right to 180 and maintain 5000 ft. He acknowledged and informed Approach that since his wingman had a bad IFF, he would take him down and then waveoff for

reentry. Approach Control acknowledged and then cleared the flight to descend to 2700 ft and maintain heading 180. Lead acknowledged.

At 1917 Approach Control relayed the current Rainbow weather. It was reporting an indefinite ceiling, 200 ft. obscured, with visibility $1\frac{1}{2}$ miles in very light rain and fog. The forecast hadn't held up! Having finally learned that destination weather was well below his previously designated minimums of 300 ft and 1 mile—established for their single-plane approaches—it seemed that Lead was being handed an open invitation to proceed to his VFR alternate, which by coincidence lay dead ahead at 100 miles.

The flight leader did not extricate himself at this point, however, and passed up what may have been his last good opportunity to salvage a badly deteriorating situation. By now he was probably approaching his saturation level, being too busy controlling his own aircraft and responding to radio transmissions to make a rational decision. The number of these transmissions was steadily increasing as the approach progressed, and the load would intensify even more a few minutes later when Rainbow Radar took control of the flight. But that's getting ahead of the story.

The approach continued . . . and with it came still another setback. At 1927, after several futile attempts to contact Navy 789, Lead concluded that the wingman was a NORDO.

At last the wingman's plight was discovered! Adherence to squadron doctrine, which requires the flight leader to make the first transmission to his wingman after each frequency change, would have precluded the very thing that eventually happened in this case . . . *a dangerously prolonged delay . . . before discovering the loss of section communication.*

Wingman apparently became a NORDO during frequency shift to rainbow approach control.

The quickened pace of the approach was being matched by the rapid buildup of problems and now the ice was dangerously thin. Still there was time to clean up and head south . . . if the decision could be made.

Rainbow Radar took control of the flight one minute later while it was on the base leg of the GCA pattern. The turn to final was late and a bad overshoot resulted. Additional instructions and responses were necessary to correct the flight back to the inbound course of 360. The burdened flight leader was now transmitting about every 10 seconds as he maneuvered into position to intercept the glide path. He rogered for the current Rainbow weather again (it hadn't improved), the lost communication procedures and precision minimums. At 1923 he was cleared to descend to 1200 ft and perform landing checks when level. One minute later he rogered for the missed approach procedures.

The pace quickened perceptibly from then on. At 1925 the flight was turned over to the Final Controller. One minute later, he asked Lead if the wingman's wheels appeared to be down and locked. There was a short pause and then Lead replied that he was waving off, and that the wingman was just below him. A few seconds later both aircraft disappeared from the precision scope. Time had finally run out 5 miles short of the GCA touchdown point.

In commenting on this tragic accident, one endorser got right to the crux of the matter. He suggested that all pilots should constantly remind themselves that "they are the individuals in jeopardy, not the collective aerologists, tower operators, controllers or other grounded agents.

"Whenever they as pilots are directed to perform a task or maneuver which they consider may hazard them or place them in extremis, they must protest. Where justified, they may forcefully ask for an alternate move by the ground agent, and be ready to change their course of action if it is not forthcoming.

"Had either pilot in this instance refused to shift frequencies during the descent, Center would have been justified in working them on Guard.

"Had the Flight Leader refused to be distracted from his own instrument scan to answer a request to check his wingman's gear, the accident might not have occurred.

"Had either pilot *insisted* upon being informed of current (Rainbow) weather in the early stages of the approach, they most likely would have diverted."

Which Way is 'Down'?

By LCDR C. B. Sawiak, VP-31

The term "Down," when referring to an aircraft, is one of the most nebulous in use in aviation, ranking with the overworked Thumbs-up signal.

When a plane was down in the old days of wire, fabric and one-lung engines, this probably meant that it simply wasn't capable of flight. This interpretation has unfortunately persisted to some extent to the present day, leading to misunderstandings between the maintainers and the operators and many times catching the poor pilot in the middle.

Whether a specific aircraft is down at a given moment depends on various considerations other than its mechanical condition, and, unless this is understood, pilots are likely to launch inadvertently in a "down" aircraft.

Let's look into some of these considerations. Take aircraft No. 1—"Up" by the maintenance department for flight. It is scheduled for a local training flight. The field weather is IFR, and is expected to remain so. Now for the problem: Birddog, omni and tacan equipment are inoperative and station GCA is out of service. Although this aircraft is perfectly capable of getting airborne, it is down for purposes of the assigned mission, because the pilot would be unable to return to the field under IFR flight conditions.

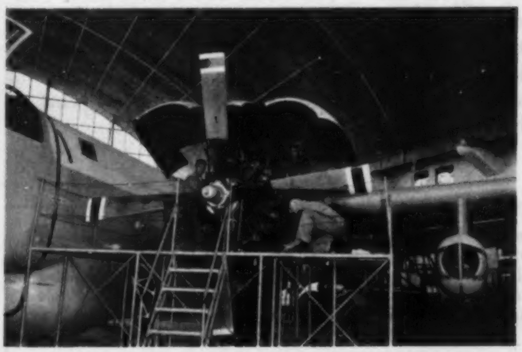
Consider aircraft No. 2. It is "Up" by maintenance for flight, having only one minor gripe . . . the copilot's ICS is inoperative. This plane is scheduled for a local FAM instructional flight in which the student pilot will practice landings from the left seat. It is easy to understand the reluctance of the flight instructor to take this perfectly flyable airplane on a hop during which instant, clear and reliable communications may be necessary between the pilots. Is this aircraft now up or down? Probably down, unless the instructor has lungs like a bull moose and decides to go ahead with the flight.

Now let's consider aircraft No. 3. It is a multi-engine ASW-equipped aircraft with two AC generators, one of which is inoperative. Normally this would be a downing gripe. But suppose we have a SAR situation in which an aircraft is needed immediately for search 500 miles at sea, and this is the only plane available? Or what if this same aircraft was already in WestPac and was needed immediately in direct support of fleet operations in the Vietnam area? Now would it be considered up, or down? These are examples in which humane or operational necessities may have a direct bearing on the status of an aircraft.

Now for a look at aircraft No. 4. It is a four-engine aircraft but one engine is inoperative. A typhoon is approaching the station and expected to arrive before the inoperative engine can be repaired. Limited hangar space would prevent sheltering this particular aircraft during the storm. Is it up, or down for a typhoon flyaway? An easy solution? Perhaps, but not so fast! Suppose the plane commander is grounded, and the only pilots available are 3Ps, having just recently qualified as safe for solo in the bird? Someone is going to have to make a hard decision. The point is that the decision as to "Up" or "Down" can also depend on the abilities and experience of the specific pilot concerned, when matched with a specific aircraft.

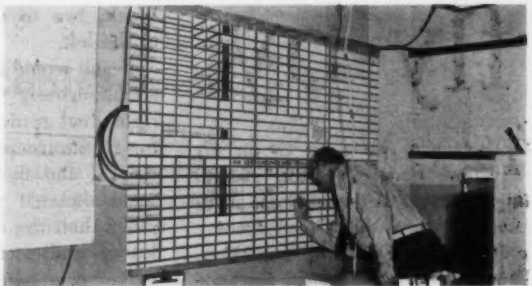
Perhaps by now you may be thinking, "So what else is new"? In the final analysis, haven't pilots always had to make the final decision of whether or not to go? What is *new* is that with the increased sophistication of aircraft the pilot must be more critical of its performance before a flight, even if it is technically "Up" by maintenance standards.

Many a new pilot may be reluctant to down a flyable aircraft even though he may not feel it has enough "Up" equipment to safely perform the mission. This reluctance may be even harder to overcome if the plane has been flying with the discrepancies for some time. His judgment, which may not have matured, may be influenced by a fear of being labeled a slacker, or of being accused of not being able to hack it. How many aircraft have taken off and been lost . . . yes, effectively lost *before they ever took off* because the pilot was reluctant to down the aircraft (when he should have) in his determination to make the flight schedule?



An aircraft may be airworthy but still be DOWN for a particular mission.

In actual practice the decisions required in these four examples are complicated by all of the potential factors, including the one factor singled out in each example.



Scheduling requires a proper mating of aircraft, crew, and mission requirements.

With the current situation in WestPac requiring increased numbers of flights every day, squadrons are being forced to consider operational necessity to a greater extent than they have had to in the past.

Whether an aircraft should go on a particular mission may depend on many factors which can only be resolved at the last moment in some cases. This decision may be made at the maintenance level, at the pilot's level and at the C.O.'s level or even higher.

What is prudent depends on the situation. The decision, at whatever level it is made, requires a complete knowledge of all the circumstances existing at the time and a fine sense of judgment that is tempered by experience. How many aircraft have been lost in the past because of an improper or hasty decision involving one of the above factors?

If an aircraft fails to complete a mission, or fails to return as a result of an emergency instigated or aggravated by known mechanical discrepancies, the results can only be justified if the decision to launch it was sound, having been weighed by all the known circumstances, or if the decision was unavoidable due to humane or operational considerations. However, any aircraft that is lost because of a mismatching of machine, pilot/crew, weather, mission and necessity is a needless waste.

fly-by

There are two sides to an air show. People on the ground might marvel at the intricate maneuvering where the airplanes weave around without hitting each other. From the cockpit view the intricate maneuvering might have been a wild series of near misses which leaves the pilots slightly shook.

Where there is no chance for flight rehearsals or practice and preparation must be limited to ground briefing, remember that there can be a few slips between the briefing and the flight.

The situation I was involved in developed when one division of aircraft from each of three squadrons was to make a fly-over in conjunction with a change of command ceremony at a nearby naval installation.

The pilot who was to lead all 12 aircraft briefed for a "V" flight formation consisting of three diamonds; Burner Bangers in front with the flight leader, G-busters to starboard, and Hotshots to port. Following the fly-by we would return to Home Plate, maintaining a "V" formation, and perform a spectacular break. It would go thus: Burner Banger leader would give the signal. G-busters would break to starboard and Hotshots would break to port. When a suitable interval appeared the Burner Bangers diamond would break, two to the right and two to the left.

Result would be aircraft landing simultaneously on the left and right dual runways—a good show for all the troops. However, on the day of the fly-by the prevailing wind dictated use of a runway other than the duals, so the flight leader indicated that he would make arrangements with operations for us to be given the duals upon our return for break and landing.

We all got airborne and proceeded to the rendezvous point but the flight leader experienced intermittent radio problems and relinquished the lead to the second senior Burner Banger. Fortunately an airborne standby had been provided so the former flight leader pulled out and the standby filled the gap. The fly-by over the ceremony area was accomplished without incident (A slick performance sure makes you feel good and charges up the 'ole tiger blood).

On return to Home Plate, initial contact was established with the tower indicating intent to enter the break between the dual runways in "V" formation with a flight of 12. Tower indicated the dual was not the duty runway and requested compliance with normal traffic. Apparently there was a lack of coordination somewhere along the line between flight leader, operations, and tower.

Eventually, after a number of transmissions the tower understood our plan and issued clearance accordingly. In the interval, one Burner Banger expressed the fact that he would be too heavy to land upon arrival. With this new information in mind, the leader declared that Burner Bangers would not break but would lead the left and right divisions into the break, then depart the pattern to reenter for a normal break. This was probably the most sensible decision of the day, but unfortunately it was reversed at the last minute.

The G-busters and Hotshots got the signal to break from their diamond formation, the outboard and slot man banking away first. At this time the original leader, who had relinquished his lead prior to the flyby and who had maintained radio silence to this point, transmitted the signal for the Burner Bangers to break, two to the left and two to the right.

There was not enough interval. The result was a three-plane near-miss to the left side and a three-plane near-miss to the right side. Everybody successfully dodged and it was spectacular. Now what do we plan for an encore?

Stowed Yoke

During a WestPac ASW mission the PC of an S-2D was in the left seat while the 2P was in the right seat practicing Julie plotting.

At the completion of the problem I suggested that the copilot take the left seat for some MAD practice. NATOPS procedures were followed for the seat switch and when I was firmly in the right seat we were losing altitude slightly (100 fpm).

I attempted to climb back to 1000 feet using AFCS—CWS, but the yoke seemed to be held by AFCS (it worked fine on the left side). Since there was no movement I disconnected the AFCS. Still locked!

Then I noticed that the yoke was disconnected and I rapidly engaged it. Upon noticing my action the comment from the 2P was, "Oh, I forgot to tell you. I stowed the yoke to plot Julie."

Plane Commander comment: ;!*:?*!;:?- The yoke lock wasn't part of my pre-switch seats check list, but it is now.

Mobile Canteen

After a 0530 carrier qual brief at NAS Training Command I preflighted my TS-2A which had already been given a CQ preflight by the plane captain and a thorough preflight by the student. We proceeded to the ship in formation with myself in the left seat for one T & G and two arrested demo passes.

After completing these we switched seats and the student made two T & G and two arrested landings. On his second deck launch he did not rotate as we crossed the No. 1 elevator so I took a quick glance at the flap setting to make sure we did not have full flaps set. The flaps were at 2/3 and I noticed the student was tugging on the yoke. I frantically grabbed the yoke and we both were pulling as hard as we could but we could not move the yoke past the neutral position. We left the bow slightly nose down and regained level flight approximately 10 ft above the water.

Sometime during these frantic few seconds I instructed the student to pull the G-limiter and autopilot manual disconnects, raised the gear, and got out a transmission that I had a locked yoke. During this flail I remember hearing the air boss calling, "59, rotate on takeoff."

After pulling the autopilot disconnect I regained elevator control and climbed to Delta, got my voice back down to a normal octave and made a few maneuvers to test the controls. Assuming it was an inadvertent autopilot engagement or G-limiter malfunction I informed the ship that I had everything under control and was ready to continue. Some Wiser-Soul-Than-I in pri-fly said "Negative, your last steer to the beach is 300 degrees at 30 miles."

I reported "feet dry," switched to NAS tower freq, which had already been informed of my situation, and requested a downwind entry. After informing the tower that I was having no difficulty I was cleared to enter downwind. Upon starting my turn off the 180, again I was unable to bring the yoke back past the neutral position. I declared an emergency and set myself up for a long straight-in. By using power I was able to control the nose attitude but with both of us on the yoke we were unable to flare on touchdown and it was a three-pointer.

On inspection after shutdown maintenance found a water canteen wedged in the yoke track between the rudder pedals, restricting the movement of the yoke aft of the neutral position. During this tug-of-war the student and I succeeded in partially crushing the water filled steel canteen and denting the 2½-inch diameter steel tubing attaching the yoke to the elevator control cable.

From now on I'm giving a lot more attention to *loose gear* in my aircraft.

Reader Questions Headmouse Answers

Unlike the flight control systems on present day high performance aircraft—the Naval Aviation Safety Center desires a continued feedback.

Has information in any Safety Center publication ever helped you to prevent an accident, avert an injury, or deal with an emergency in a better way?

If so, and you have not already informed the Safety Center, it is particularly desired and important that you do so. Such feedback is vital to all departments at the Center and for fiscal support of our safety research and education program.

Have you a question? Send it to Headmouse, U. S. Naval Aviation Safety Center, Norfolk, Virginia 23511. He'll do his best to get you and other readers the answer.

Mk-5A Anti-Exposure Suit Neck Zipper

Dear Headmouse:

On the Mk-5A anti-exposure suit, the neck zipper slider has two sharp prongs that stick out. As the wearer tries to zip up the neck zipper, the prongs catch on the soft rubber on the zipper and tear a gash. When the neck zipper is torn, the suit must be sent to O&R to have the zipper replaced.

To keep the slider from ripping the soft rubber on the zipper, thus ruining a Mk-5A anti-exposure suit so that it requires O&R repair, I have modified the slider by removing the sharp prongs. The prongs are very easily removed by using a pair of end cutters. You place the end cutters at the end of the prong furtherest from the point and cut the prongs off. After removing the prongs, use a small file to smooth the sharp edges.

I recommend that all Mk-5A anti-exposure suits have this done to them. It would save a great deal of money and time.

L. A. GROSBIER, PR1
VP-17, AVIATION EQUIPMENT
FPO, SAN FRANCISCO

▶ You have a very good point here. Your squadron's method has been forwarded to BuWeps. In addition, it was recommended to BuWeps that *Clothing and Survival Equipment Bulletin 10, Coverall flying, anti-exposure, Mk-5A*, be revised immediately to 1) give adequate procurement data for all components for the Mk-5A anti-exposure suit, 2) provide instructions for cleaning the outer coverall, and 3) establish levels of maintenance at which various repairs will be made.

Very resp'y,

Headmouse

Mk-4 Life Preserver

Dear Headmouse:

The Mk-4 life preserver integrated with the MA-2P harness was designed for use with the full pressure suit. Conditional approval has been granted to use the Mk-4 and MA-2P with the Mk-5 anti-exposure suit. What is the official stand on the use of this gear with the summer flight suit?

ED CAMPBELL
GRUMMAN CORP.

▶ The MA-2P harness with the Mk-4 life preserver is designed for use with the full pressure suit only. Conditional authorization to use the MA-2P harness with the Mk-5A anti-exposure suit has been given by BuWeps for those squadrons only which are allowed Mk-4 preservers, MA-2P harnesses and full pressure suits.

Very resp'y,

Headmouse

UR Trouble

Dear Headmouse:

For reasons unknown, I had a lock failure on the switch blade of my MC-1 survival knife (S/N 9D7340-526-8740). I tried to UR it but was told I could not because the knife is a consumable item.

I recommend that all aviators/aircrew using this knife be made aware of the hazard and that all check this item before each flight. PR's should periodically inspect these knives. This program has been instituted in VC-5 as of today.

C. D. KEETON, PR1
VC-5 PARALOFT

▶ The Aviation Supply Office, Philadelphia informs us that if a local stalemate does exist on proper procedures for initiating a UR, a letter report can be made to the Bureau of Naval Weapons (RAAE in your case) with information copies to ASO and NASC. There should be no problems involved when submitting a UR on items that were procured with government funds, open purchase.

Very resp'y,

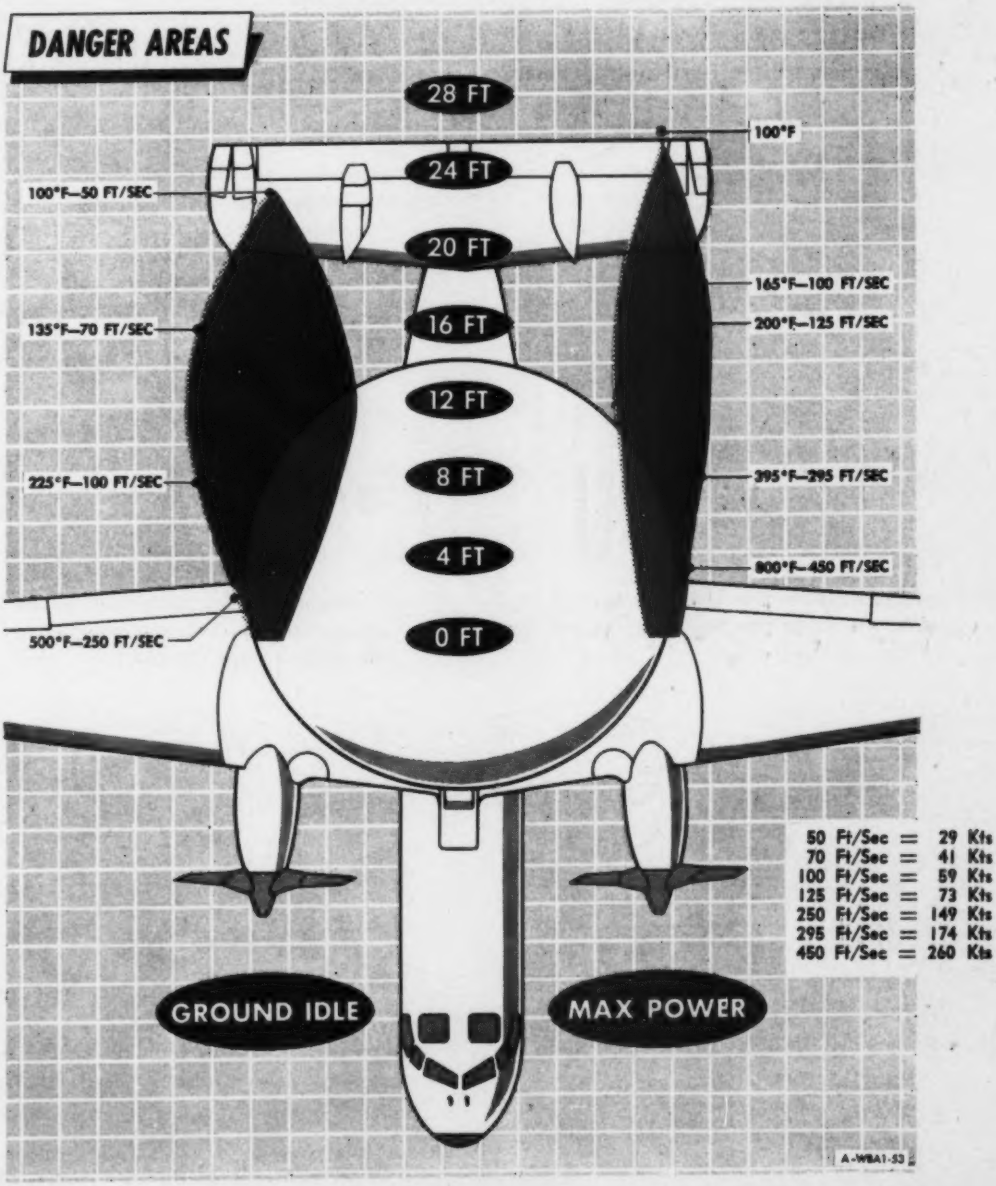
Headmouse

Turboprop and jet blast

Turboprop operators have asked for prop and jet blast information. While a variety of charts exist, none give a complete presentation.

This one, for the T56 powered E-2A, shows only jet blast temperatures and velocities at ground idle and max power. A C-130 chart warns that at 500 feet with engines at full power, prop blast equals 30 kts—forces being proportionate to horsepower being absorbed by the prop varying from ZERO thrust upwards.

Beware also of prop blast in REVERSE thrust—it has been known to damage aircraft 100 feet directly *in front* of the props. Ramp dirt and debris have blinded and otherwise injured ground crewmembers.



Have

You

Ever...

. . . installed an electrical connector without checking inside both mating halves.

. . . installed a plug-in type black box without checking to see if the tape has been removed from the electrical connector.

. . . broken a wire by pulling on the wire bundle going into an electrical connector to aid in disconnecting the connector.

. . . left loose hardware in an electrical J-box.

. . . soldered a wire to a pin in an electrical connector that has ceramic inserts without using a heat-sink.

If you have done any or all of these things, let this b

. . . broken a ceramic insert in an electrical connector by prying the two pieces apart with a screwdriver.

. . . wished that you had read the Maintenance Manual before you started to perform a particular task.

. . . gotten a pretty bad jolt because you forgot to tag the power control switch before you started working in a high voltage area.

. . . sent a replaced part to the shop to be checked or overhauled although the new part did not fix the trouble.

. . . had to replace an electrical connector because you had tried to install it with improper tools.

. . . used a test meter with improper meter leads.

this b a reminder. If you have not, let this be a caution.

—Adapted from an Airlines Bulletin

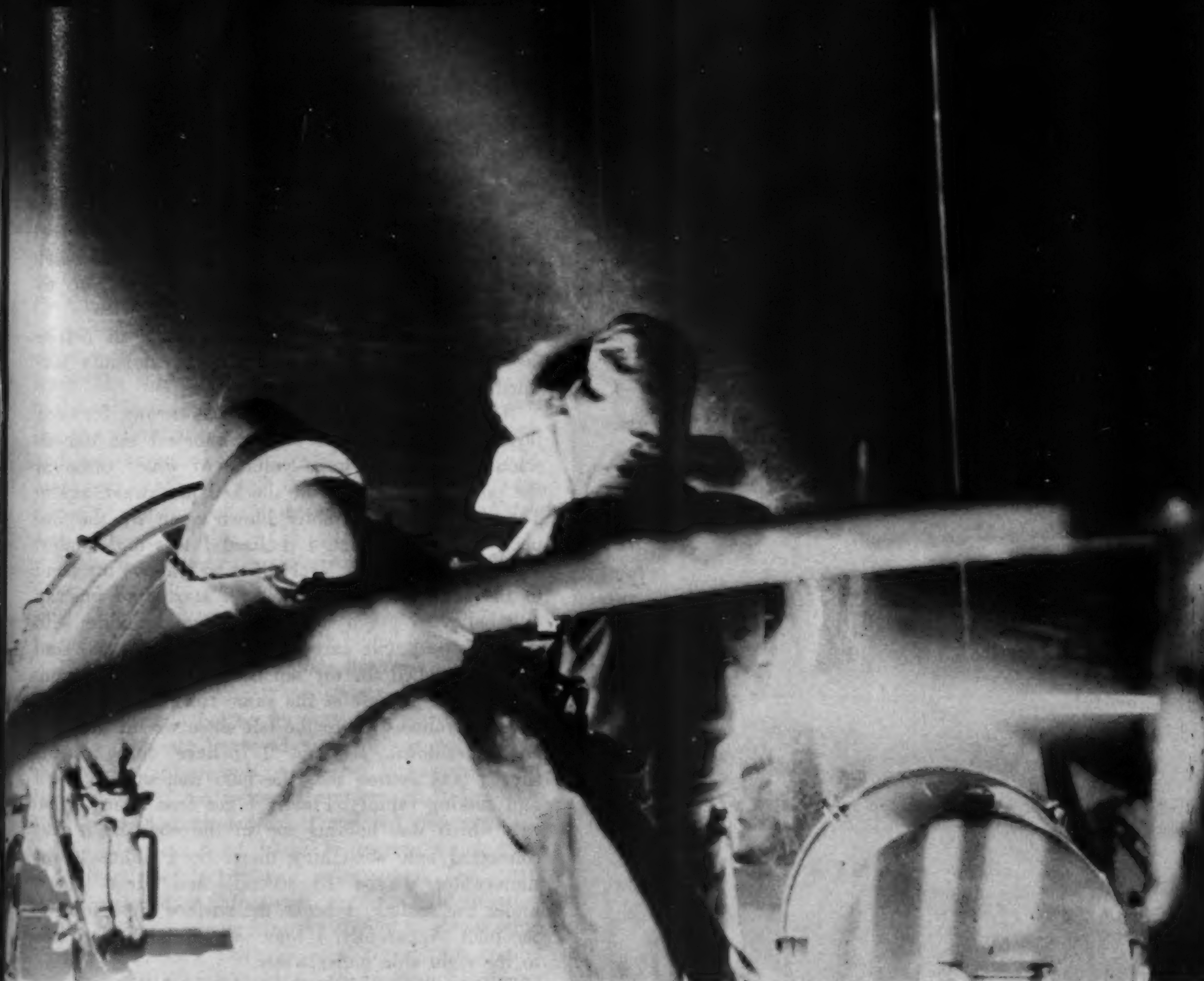
FALLEN ANGEL

Aboard a carrier at approximately 1945 on a winter day, a UH-2A was manned by pilot, copilot and two crewmembers to cover the 2020 launch and 2150 recovery. Liftoff was considered normal in all respects. While assuming angel station, the pilot commented that the helicopter was very smooth running. The crew concurred.

Control of the aircraft was passed back and forth several times between pilot and copilot. The copilot was practicing instrument flying while maintaining station when, at approximately 2150, both the pilot and copilot heard an explosion and then a "large snapping sound." Violent vertical vibrations immediately followed—so violent that neither pilot nor copilot could read any of the instruments.

The copilot at the controls reacted with full right cyclic and rudder. The pilot came on the controls in the same manner and lowered the collective. Just before the helo hit the water, the pilot raised the collective with no apparent response. The helicopter struck the water in a flat or slightly nose-down attitude with a small rate of turn to the left. Forward speed was about 10 to 20 kts. (The aircraft investigation board concluded that the cause of the accident was "undetermined." They suspected that one or more main rotor blades failed due to the failure of a retention assembly or servo flap.)

The pilot was strapped in the right seat. Impact was severe enough to tear his seat loose and throw him forward, to the left, and into and under the instrument panel. The copilot's seat remained in place. The crew saw the light of the moon through the



windshield before the cockpit became completely submerged. The aircraft then rolled to the left and sank.

The ATR3 had a greal deal of difficulty maintaining his footing during the vibrations. Thrown back into the seat on the port side, he was bounced violently between seat and overhead until collision with the water. His left elbow was cut and bruised.

The AN was not seen again after the vibrations began. He had been crouching next to the closed port hatch to observe flight operations on the outbound pattern leg.

During the accident, the pilot suffered mild compression fractures of two thoracic vertebrae and a muscle sprain of his back. The investigating flight surgeon theorizes that the fractures were incurred when the pilot's seat broke loose, throwing him forward and wedging him between the seat, deck and instrument panel.

The pilot believes he removed his helmet while trying to free himself. He then straightened up and thinks he remembers striking his head either on the overhead or the door while leaving the aircraft. However, his helmet chinstrap was very loose before the accident. It is possible that his helmet came off during the violent vibrations and, as he was thrown forward on impact, his head struck the instrument panel.

As the helo continued to sink the pilot released his harness. He became disoriented. He pulled himself out of the aircraft "with the aid of the buoyancy of the anti-exposure suit." The pilot's recollection of

details following impact and during rescue is spotty. When he reached the surface of the water, he was dazed and in a great deal of pain. The surviving crewman answered his calls for help and inflated his life vest for him. The pilot managed to inflate the life raft himself but because of his condition could not get into it. The crewman helped him hang on to the raft until rescue came 20 minutes later.

In spite of having been well strapped in before the accident, the copilot was snapped violently forward as the helo hit the water.

"Upon impact," he recalls, "I was thrown forward jarring my back. This almost knocked me unconscious, but as the huge volume of water came in the port hatch, it kind of shocked me awake again. The door was apparently blown open by the impact. Right after that, I realized I was underwater. I could see the water level going well above my head to the ceiling and beyond. So I started to unstrap and believe I got a little tangled up in there with my back pack (we carry a little PK-2 with us) and when I reached for my lap belt, I believe I disconnected my life raft at the same time. The helo apparently rolled over to the left since we hit in a left and nose-down position. I believe that at the time I was getting out, the helo was upside down and sinking rapidly. Finally I got free of my pararaft which was holding me in the cockpit. It was connected onto something there. So I figure I was underwater maybe 15 seconds and about 15 ft under the surface. I broke the surface right next to the pilot. Apparently, I went over from the left side to the right side under water."

The copilot recalls pain in his back immediately and he became more aware of severe back discomfort as soon as he reached the surface of the water.

The copilot had left his PK-2 life raft behind in the sinking wreckage because of an established habit pattern, the flight surgeon believes. At the conclusion of each hop in the UH-2A, he was in the habit of first freeing the lapbelt and then freeing his backpack harness.

"After many times," the flight surgeon says, "this

pair of actions probably became nearly inseparable, without conscious thought. He apparently performed this same habit pattern to egress underwater."

As soon as the helicopter had hit the water, the ATR3 started to walk out the starboard aft hatch. He got outside the aircraft with his head above the surface of the water and tried to free himself from the gunner's belt around his waist. (At this time, no one else was out of the aircraft.) He pulled the release on the gunner's belt, but it would not release. The safety, which had not been in place prior to the accident, had apparently slipped into place during the vibrations. The helicopter continued to sink and he was pulled under water again. Somehow, he managed finally to pull the safety up and release himself from the belt. He escaped through the hatch and surfaced.

When the crewman surfaced the second time, both pilot and copilot were on the surface. The crewman inflated his life vest, then as stated above, swam over to the pilot who was calling for help.

The crewman tried to inflate his own PK-2A raft but, even after pulling it completely out of its pack and spreading it out on the water, he was unsuccessful. He does not know whether he was not pulling the toggle hard enough or whether it was stuck, but the raft would not inflate. He unhooked it from his life vest and discarded it; it was not recovered.

The survivors fired 10 to 15 tracers which were seen from the carrier two miles away. The crewman retrieved a 2-foot sea marker light floating in the water and gave it to the copilot to signal with. Using the pilot's raft for a platform, the copilot signaled with the sea marker light to the approaching destroyer.

"All three of us had our life vest mercury lights turned on," the crewman recalls. "My light helped out a great deal but sort of blinded my right eye.

"The ship came alongside and lowered a whaleboat and crew. Somehow, their directions must have been all mixed up because we were alongside the ship and the whaleboat was way out from us. They threw lines over the side of the ship and tried to grab hold. . . couldn't at first, but finally the copilot and I got one each. They pulled me up with mine."

The copilot was hoisted in a Stokes litter.

"We were scraped down the side of the DD and were burned by hot water discharge," he recalls. "They used a litter lowered into the water to pick me up. Two swimmers in the water rolled me from the life raft into the litter. This is a very effective way to raise a pilot from the water. The great weight of one's gear and 15 minutes in the water leave one pretty tired. The swimmers did an outstanding job. Use of a portable megaphone earlier in the rescue to alert survivors that they have been sighted would be good. Incidentally, the searchlights from the ship did not blind us; they produce a very comfortable feeling."

The pilot was assisted up a sea ladder onto the destroyer deck with the aid of swimmers and deck hands. The flight surgeon reports that although the pilot's "vital signs" were normal and he was fairly well oriented, his skin was slightly bluish on rescue, and for two hours after being brought aboard.

"Without the aid of the crewman, especially, and the copilot," the flight surgeon stated, "he might not have survived."

The surviving crewman had practiced survival swimming many times, most recently two months before the accident. Some two months before the accident the copilot had practiced survival techniques with his anti-exposure suit on. He stated that this training "certainly helped" to make him less anxious during the survival and rescue phases. The pilot had had no personal survival training in recent years.

The ship came along side and lowered a whale boat . . .

The copilot was wearing thermal underwear under his Mk-5 anti-exposure suit and the pilot, a flight suit and flight jacket under his. Both crewmen were wearing wet suits. At the time of the accident, the pilot had the neck of his suit open for ventilation. The suit filled with water and he suffered moderate exposure. The copilot's suit tore across the left shoulder and upper arm, probably during egress. His suit also filled with water, contributing to mild exposure.

The aircraft accident investigation board was of the opinion that the rescue operations as carried out by the destroyer were outstanding. In particular, the board considered the use of the Stokes litter to hoist injured personnel from the water highly effective and recommended that all vessels employ this method of rescue whenever possible.

SHARED

When a stall spin developed after a high yo-yo maneuver, the F-4B crew ejected at 3000 ft. Ironically, the squadron briefing emergency of the day had been overwater ejection.

Although not in accordance with prescribed NATOPS procedure, the pilot after ordering the RIO to eject, ejected himself first. However the Aircraft Accident Investigation Board considered this was justified by the altitude and attitude of the airplane at the time. The RIO, concentrating on the radar, was totally unaware of any difficulties until told to eject. As the Board pointed out, "the RIO's situation would have been much improved by some prior descriptive commentary or exclamation as things went from bad to worse."

Here first is the pilot's recollection of events with a gap in his memory for the period from ejection to water entry. Apparently dazed by a blow on the nose from the drogue gun piston assembly, he remembers nothing that happened during the parachute descent. Once in the water he released the parachute and seat pan and pulled the toggles on his Mk-3C. "This action," the AAR states, "speaks well for the squadron's and the pilot's personal survival training."

"As we broke through the cloud layer at 3500 ft, still low airspeed and 70 degrees nose down," the pilot states, "I told the RIO, 'Get out, Bill, get out, eject!!!' and pulled my face curtain. I remember seeing the face curtain come down, hearing the seat fire and feeling the wind blast. The next thing I remember is being submerged in the water at what seemed like a great depth."

The RIO's narrative fills in the gap in the pilot's story. . .

"As I was descending, I shifted in my risers to try and locate the pilot. I found him a couple of hundred feet lower than I and about 100 ft away. I pulled my face mask away at this time and shouted to him, trying to get his attention. When there was no response, I pulled on one riser to position myself closer to him. When I got within 40 or 50 ft and slightly above him, I called to him again. At this time he looked towards me. I took my helmet and mask off

EQUIPMENT

and threw them away while he was still looking at me. He responded and did the same.[1]

"I noticed at this time that the pilot was bleeding from the nose. As we continued down, I tried to get him to tell me if he was all right but he did not respond. When we were about 50 ft above the water I yelled at him to get his attention for he was just hanging by his risers. With continuous calls I finally got him to look at me. I then pulled my kit release handle to open my raft. I had hoped that he would respond to this as he had done earlier with his face mask and helmet but he did not. We were now rapidly approaching the water so I devoted my attention to the water entry. . ."

Now back to the pilot's story as he enters the water. . .

"At this time I apparently pulled the toggles on my Mk-3C life preserver, although I don't actually remember doing it, and I surfaced. I was still very dazed and couldn't remember where I was. I kept thinking I was somewhere off the coast of California. After a couple of minutes, still not completely alert, I surveyed my gear, discovered I was missing my pencil flare gun, my seat pan and raft, and my helmet and mask. I lost my pencil flare gun on ejection. I had been carrying it in one of the pencil holders on the left sleeve pocket of my flight suit.

"Apparently either by instinct or training I pulled off my helmet and mask, released my parachute, released my seat pan and raft and pulled the toggles of my Mk-3C during the period I was not fully conscious.

"After a few minutes, as I was riding over the top of a swell, I saw the RIO about 100 yards away. The sea was pretty rough, 25 to 30 kts of wind from the northeast with 10 to 12 ft swells. I tried to swim toward him but I seemed to be making very little progress and kept losing sight of him. I finally took a bearing with my compass and tried to swim in that direction. I put my whistle in my mouth and every time I was able to catch sight of him, I blew it, hoping to get a response. Apparently he didn't hear me. After a few more minutes we finally rendezvoused. . .

"The RIO was in his raft and had the PRC-49 radio out. He tried to make contact but we weren't able to talk to anyone. He said the radio apparently had leaked and was shorted because he was being shocked. He made a couple of MAYDAY calls giving our last known position.[2]

"The water seemed to be very cold. The wind was giving me a chill and I was shaking pretty badly.[3] About this time a swell broke over the top of us and overturned the raft. Once we got it righted, I climbed in to try to relieve the chill. We were both tied to the raft to keep from losing it.

"We checked our survival equipment. We still had my pistol and tracer ammo, a survival knife, a strobe light, two whistles, two compasses, four day/night distress signals, one pencil flare gun, the PRC-49, SEEK kit and raft. I tried the PRC-49 again but it seemed completely dead so we gave up on it. . . .

"At 2000, after I had been in the raft for about two hours, we changed places again. To prevent the raft from overturning again, whoever was in the water kept the foot of it turned into the wind against the swells. This seemed to work very well.[4] The only time we would get dunked was when a swell would break over us. Back in the water again I was cold and shaking but tried to be as comfortable as possible. Having seen nothing and no one, we were mentally prepared to spend the night.

"At approximately 2045, I saw the red and green lights of an approaching aircraft. I called it to the RIO's attention and pulled out my pistol, firing two tracers in front of the aircraft. The RIO fired a pencil flare directly over our heads and as the plane

[1] Throwing the helmets away was a mistake. Retention would have increased chances for location in the water because of the reflective tape. Helmets also provide protection against possible head injury during pickup.

[2] The switches were taped over with ordnance tape but the investigating flight surgeon reports that even after the RIO removed the tape, the PRC-49 did not function.

[3] Both water and air temperature were 77° but wind velocity was 25 to 30 kts.

[4] No mention is made of the sea anchor.

'...I fired a few more tracers and the RIO lit a night flare...'

approached, the pilot revved his engines and commenced an orbit over us. I turned on my strobe light which was mounted on the chest strap of my torso harness, but my Mk-3C seemed to ride over the light and the light would also be submerged occasionally in the rough water. I tried to unsnap it and give it to the RIO in the raft but I was unable to do so. Finally with my knife we managed to cut the holder loose. The RIO then held the light overhead as a beacon.

"Soon after the first plane arrived several more aircraft arrived and began dropping parachute flares. The first two didn't seem to be very close so I fired a few more tracers and the RIO lit a night flare and fired a couple more pencil flares. He said he was getting short of pencil flares so I reminded him I still had mine. We discovered, however, that we had two different types of flare guns and my flares would not fit his pencil.[5] The aircraft dropped two more para-flares, this time directly overhead which certainly made us feel better.

"At about 2115 I saw the searchlights of the helicopter coming toward us so I fired more tracers and ignited one of my night distress signals. The RIO used his last pencil flare. The helo was soon overhead so we untied ourselves from the raft and abandoned it. They dropped the three-pronged rescue seat very close to the RIO and he got on and was hoisted up.

"After the RIO was picked up, the helicopter seemed to drift away and I was without a signal light as the RIO had taken the strobe light with him. I was about to use my last night distress signal when the helicopter arced around, came back and lowered the seat to me. I boarded the seat, using all three prongs. Other than my being doused by a couple of swells, the pickup was smooth. We were brought aboard the carrier. . ."

The Aircraft Accident Investigation Board summarized their findings on survival equipment and procedures in this case:

"Many pieces of survival equipment played important roles in the survival phase of this accident. The Mk-3C was the only flotation equipment available to the pilot (except for inflating his anti-G suit) since his raft was missing. The RIO's raft provided eventual protection from the elements. Even though the water and outside air temperatures were in the 70's, both crewmembers complained of the cold due to the chill factor involved with high winds. The pilot's tracers were reported to be visible for 8 to 10 miles while the RIO's pencil flares were estimated to be visible for 20 miles. The strobe light was also credited with being of great value in maintaining position and during helo rescue.

"The RIO's standard flashlight with white light remained operating the entire period and was seen along with the strobe light for one to two miles. The flashlight was attached by a single nylon cord around the RIO's neck and hung down between the two snaps of the Mk-3C on the torso harness. No difficulty was experienced whatsoever with the flashlight and it proved a most desirable survival item. Mk 13 Mod 0 night distress signals were utilized and were easily seen. . . .

"The only difficulty during the rescue was that the first man to go up on the seat had both the flashlight and strobe light, leaving the other man who was without his helmet with reflective tape, in the water, with only one day/night distress signal left. The helo crew lost sight of the man in the water for only an instant but they could have lost him completely in the darkness. . . ."

Both pilot and RIO recommended ensuring that all pencil flare guns in each squadron be the same type.

The pilot recommended using shroudline and other appropriate lanyard to attach every piece of survival gear to a permanent part of the flight gear and repositioning the strobe light to a more readily visible spot or making it easier to release for overhead use.

The RIO recommended "having the contractor look into this water leakage problem in the PRC-49." He lost his strobe light during ejection and recommends that the light be positioned below the riser locks of the Koch fittings so that it will remain on the torso harness.

This accident also calls attention to the necessity for making sure any survivor temporarily left in the water during pickup has some sort of signaling device.

[5] With the Mk 79 Mod 0 now the authorized pencil flare gun, there should be no such problem in the future.

over the side

On the fourth pass to a carrier landing, an A-4B pilot commenced his approach with the ship turning to starboard. The aircraft rolled into short final with the ship steady on course, engaged the No. 2 pendant and rolled out toward the port side. With the flight deck still heeled to port, axial wind picked up the starboard wing causing the nosegear to pivot left. The aircraft rolled over the port side and hung from the crossdeck pendant. Before the pilot exited successfully from the cockpit he had his problems. . .

"Even as the nose dropped, I did not believe that I was going completely over and I did not consider ejection," he reports. "As I recall, my thoughts at this time were disgust because I knew that I was going to bend the airplane up some. Then followed much crunching and banging and down she went."

The pilot did not realize the aircraft was hanging over the side by the tailhook on the arresting cable.

"It (seemed to me) that she had fallen completely over the side and, after the hard jar of hitting the water, I was convinced that I was on my way to the bottom of the sea. I do not remember either opening or blowing the canopy, but I was immediately besieged by torrents of water which banged me about violently. I had the sensation that the aircraft was in a tight spin.

"I reached down and pulled the harness release handle which seemed to free my shoulders but not my lower half. Struggling fiercely to free myself from the cockpit, I even reached up to make sure the canopy was not there. Now I was really getting banged about wildly and I paused, reached down for the handle again, found it dangling and gave it another pull. At this time I was convinced that I was sinking rapidly. I had my eyes open and saw nothing but rushing water.

"As if by magic, when I pulled the release the second time I was (released) from the cockpit with no apparent effort on my part. I began feeling for the toggles on my Mk-3C life preserver and finally popped the right one. I had no idea which way was up and, as I felt for the left toggle, I prepared for a long ride. Almost immediately I popped to the surface and saw the stern of the ship go by. I was amazed. The struggle in the cockpit had seemed like several minutes, and I could not understand how I had gotten up so quickly. . . ."

The pilot was rescued by helo and carried back to the ship. His only injuries were bruises and cuts and a low back strain most likely caused by his being buffeted about by water rushing into the cockpit.

"All A-4B pilots should be instructed that their harness release handle must be pulled fully to release both shoulders and hips," the investigating surgeon states. "It is essential that pilots be periodically briefed on all pertinent aspects of their safety, escape and survival equipment."

Following an accident which results in a taut arresting cable, the flight surgeon also says, the flight deck should be cleared immediately of personnel within striking distance should the cable snap. In this accident, he states, many spectators remained on the flight deck for about 10 minutes after the accident. If the cable had broken, many severe injuries could have occurred.

Rapid Decompression

As decompression occurred, copilot's head was jerked forcibly into slipstream.

SHORTLY after a TA-3B leveled at assigned flight level 290 on a scheduled logistic flight, the right hand forward canopy enclosure panel adjacent to the copilot failed and blew out, explosively decompressing the cockpit and cabin spaces.

The copilot was subjected to the full blast of exhausting air which jerked his head forcibly into the slipstream. He was instantly rendered unconscious and held partially in the slipstream by wind upon his helmet. The torso harness attachments restrained him in his seat.

The pilot immediately began an emergency descent and notified the base. The third crewman attempted to pull the copilot clear of the slipstream but was unsuccessful until he cut the chinstrap of the copilot's helmet, jettisoning the helmet. To facilitate the third crewman's efforts, the pilot slowed the aircraft, using a wing-over type maneuver.

Oxygen was administered to the copilot while an emergency landing was made. A doctor and medical crew met the aircraft and the copilot was taken to a naval hospital for treatment. He recovered completely. (None of the other crewmembers were injured in the incident.)

"Had the copilot not been strapped in his seat, he would have been lost from the aircraft," the investigating flight surgeon states. "This incident recommends itself as a practical reminder for all to adhere to standard operating procedures in this or any aircraft, specifically in this instance, wearing of flight gear and being strapped in. As this incident demonstrates, an emergency situation may develop before life-saving action can even be contemplated."

(In a second similar rapid decompression incident occurring a few months after the one described above, an RA-3B crewman/navigator who had disconnected his rocket jet fittings for crew movement was pulled out of the cockpit to his waist. He was held from going all the way out by his legs wedging between the seat and aft panel.)

Bumps Head

PRIOR to helicopter pickup, the pilot discarded his hard hat. This in itself appears to be a somewhat harmless act, yet during the hoist ride into the helo he received a

slight bump on the head. These bumps on the head are not totally uncommon and the hard hat has been designed to protect the wearer from this type of injury. Also to be considered during any helo pickup or ride is the remote possibility of the helo crashing. A hard hat would be a definite asset in this situation.

—From an AAR

Momentary Panic

THE copilot of an S-2E which flew into the water during night ASW operations in his own words panicked momentarily and thought he would be trapped in the sinking wreckage. As he sat immobilized, he gained self-control by thinking, "It's just like the Dilbert Dunker." Then he went into action.

He tore open his lap belt and reached for the small handle just above the wind screen. By this time he was submerged as far up as his hands could reach. When he couldn't locate the handle, he grabbed and found nothing above him. Standing up and pushing off with his feet, he escaped freely from the aircraft.

As he kicked, he pulled the right toggle of his life vest and felt himself ascending. On the way up he bumped into a large piece of wreckage which he had to fight away. He estimates he must have been 15 to 25 feet below the surface when he escaped from the cockpit.

After 80 minutes in the water, he was picked up by submarine.

The survivor credits his successful escape and survival to Dunker and swimming training 2½ weeks previously, still fresh in his mind.

Attached To Chute

A pilot who ejected released both shoulder rocket jet fittings as he entered the water but remained attached to his parachute. Wind speed was only eight kts and sea state was "1." When the canopy deflation pockets collapsed the chute, he had no serious problems boarding the raft. He was about to cut the chute free when he saw a fishing boat approaching. The crew pulled him aboard, then cut the parachute away.

BACSEB 14-62 had been installed on this pilot's NB-9 parachute but in all probability it had been installed incorrectly accounting for the chute's failure to separate. (See *BuWeps Aviation Clothing and Survival Equipment Bulletin 14-62, Amendment 1*, and *NavWeps 13-5-501*, the *Parachute Manual*, on the incorporation and use of the manual ripcord housing release device actuated by a riser lanyard on the NB-5, NB-7 and NB-9 parachute assemblies. *Personal/Survival Equipment Crossfeed 12-65* also carried an item on this problem area and drawings from the *Parachute Manual.*)

Underwater Functioning of Aviators' Oxygen Equipment

Pilots and aircrewmen are reminded that their oxygen systems will function underwater. Controlled tests plus innumerable experiences during water landings and subsequent escape from the aircraft have borne this out. Whether one is in a submerged aircraft or busily inflating his flotation gear and raft in a choppy sea after ejection, the advantage of being able to breathe is apparent.

The mask should, of course, be cinched firmly to the face and in case of diluter-demand regulators, a 100 percent oxygen setting is mandatory.

As the miniature regulator is strictly a 100 percent oxygen system, there is no setting to be made.

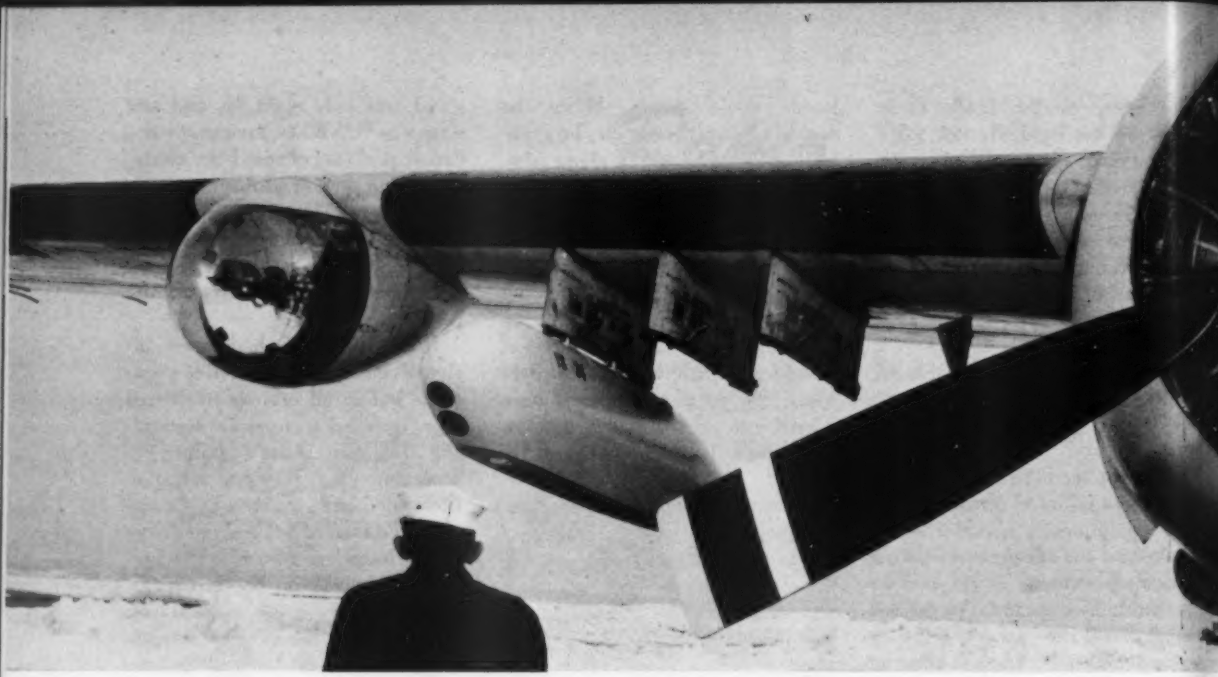
Inasmuch as oxygen regulators are sensitive to pressure at their location, the regulator's position determines the inlet pressure of the oxygen to the mask. Ideally, the regulator should be positioned on a line from armpit to armpit.

The mask-mounted miniature regulator is correctly positioned but console mounted regulators are not. If the regulator is below the chest, the inlet pressure is positive. Conversely, location above the chest will result in a reduced pressure. A one-foot depth separation in water will result in approximately one-half pound per square inch pressure differential.

In a submerged cockpit, whether upright or inverted, the correct procedure for proper inlet pressure from a console mounted regulator would be to bend the body upward toward the regulator in order to equalize the pressure on the chest with that at the regulator.

Have confidence in the equipment, understand its functioning under variable conditions and give it a chance to help you in water survival situations.

—U. S. Aerospace Medical Institute



Then came the light

By LTJG E. P. Nicholson
Ordnance Officer VS-34

**How one man brought the squadron out of the dark—
or before frustrations beset you, buy the book . . .**

"Let's try it at 50 feet."

"Maybe the test circuit breaker should be in all the time."

"Photo pods again tonight? We've got four days left and I haven't made San Juan yet!"

Frustration from failure. Failure from ignorance. Danger from frustration. An unusual cycle? Unfortunately not.

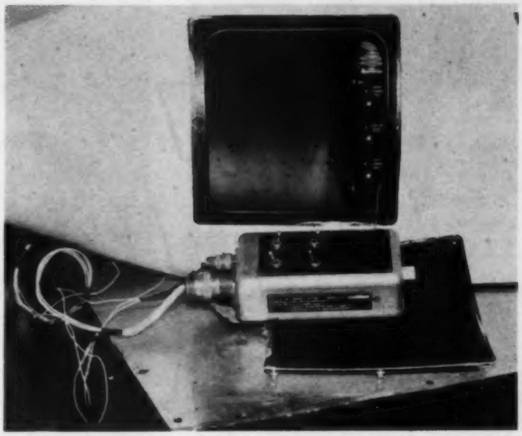
Frustration in this instance arose from the LB11A night photo pod, and the associated KB16A camera. It didn't work. It wouldn't work. We couldn't get night photo-qualified for trying. Night photo hops were biting into beach time. Patience began to fray. Guessing began to supplant head work. Frequent night rides led to hurried ordnance check lists. Intuition fostered innovation. (One pilot salvoed all 52 flares by throwing a covered switch!)

Then came a man with the information. After a look around and a mental backflip here is what our new A01 managed in two weeks. He:

- designed a simple circuit tester to check out the pod without the aircraft turning up
- pointed out that HERO conditions must be set *prior* to removing the shunt clips from the M112 cartridge (waiting until taxi time doesn't solve the problem)
- discovered that the armory was sending us 2-second delay cartridges (which foil the programmer) in boxes marked 1-second delay (the correct information is stamped on the side of the cartridge)
- found that the A6 flash cartridge ejector had at times been improperly inserted which could have led to an explosion in the pod and possible wing fire (these cartridges burn hot enough to melt the bed of a truck)
- scotched the idea that flying lower would enhance camera performance (300 to 400 feet is ideal)
- stopped the use of "outdated but still good" (it's

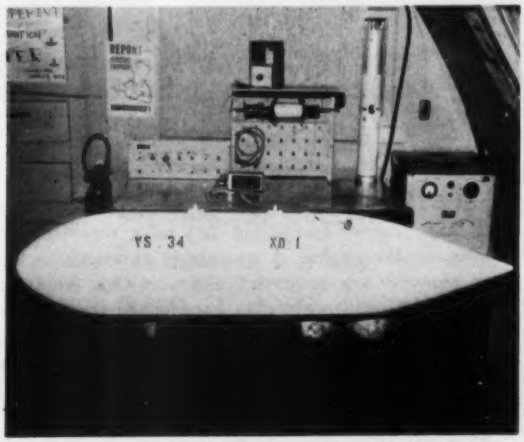
been refrigerated, guys) film and insisted on new film with an ASA of 180 or greater.

- emphasized the danger of resetting the camera programmer with the pod loaded (this amounted to night time Russian Roulette).
- incorporated a 28-volt, 7-amp outlet in the Ordnance Shop test bench which kept fluctuations to a maximum of plus or minus .5 volts and allowed a maximum of 7 amps (anything greater than that will break down capacitors and diodes in the programmer allowing a direct short to ground or 28 volts into the programmer).
- prompted the Ordnance Officer to produce new Camera Pod Check Lists and to brief the pilots on them.
- finally he pointed out to ordnancemen that by operating the test switch on the 114 tester control panel and simultaneously operating the test switch on the programmer they had been merrily burning out the programmer.



Two switches that must not be ON at the same time: "Night Camera Test" (upper right of camera) and "Test" (lower left of 114 tester control panel). Otherwise additional voltage breaks down diodes and capacitors in programmer.

LB11A stray voltage and continuity tester made from a rocket continuity tester and a two-decked rotary switch. In use it is plugged into the wing, connecting aircraft pins to the switch and meter in series and then to ground.

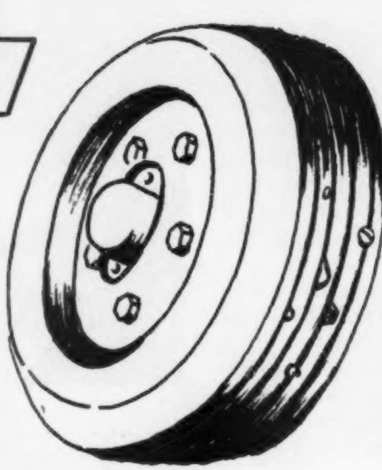


LB11A night photo pod connected to a constant 28-volt, 7-amp source is protected to a plus or minus .5 volts and a max of 7 amps through the 114 test control panel.

Yes, it had been a horror show but now our success zipped from zero point to over 90 percent. Before you look askance let us report that good news spread quickly and we were soon assisting other VS outfits.

This story ends happily. The quals are coming in. The pilots are remaining at a safe altitude. The ordnancemen and the aircraft are a good bit safer. *All because of one man who had the information.* And I think the rest of us know where we can keep our innovations, our impulses and our second-guesses.

With grateful acknowledgement to Aviation Ordnanceman First Class, F. P. Minnick.



FOD is where you find it!

a case in point

SHORTLY after takeoff on a test flight following PAR and engine change, an A-4 pilot reported explosions in the engine. A straight-in approach to the duty runway was requested and received. About a quarter of a mile out, as he approached the field, a puff of smoke was observed and the aircraft was maneuvered into a slightly nose-high attitude in an obvious effort to conserve altitude, sacrificing speed for distance.

Moments later the aircraft appeared to stall and spin. It hit the water nose-down and came to rest in six ft of water, 100 ft short of the runway. The pilot was fatally injured; the aircraft was destroyed by impact forces.

Examination of the engine revealed evidence of foreign object damage. Compressor blades had varying degrees of extensive fracture and bending with conclusive evidence of blade log-jamming. Several blades in the first three stages had leading edge damage closely matching the diameter of a No. 10 bolt.

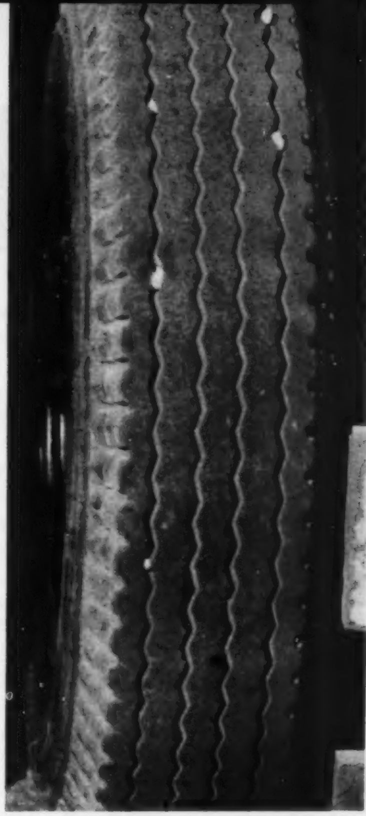
The most probable cause of this accident was assessed as engine induction of a foreign object which caused compressor damage resulting in blade failure. The gross and rapid failure of the compressor during the critical stage of the final approach induced a high sink rate which probably precluded ejection and committed the pilot to remain with the aircraft. At the time of this accident, three other incidents involving foreign object ingestions by jet engines were under investigation at this station. All ingestions had occurred within a 48-hour period.

Snow removal operations were considered to be a contributing factor in that foreign objects were introduced by snow removal and other yellow equipment. This was evidenced by the increased accumulation of nuts, bolts, wire and other objects during runway and taxiway sweepdowns.

The prevention of FOD is a constant problem. While the largest percentage of FOD is the result of people-induced hardware, GSE contributes its share. For example, one major station noted that tires replacing original equipment were close tread (automobile) type. These tires have an affinity for picking up pebbles, bolts and nuts when transiting parking lots and other areas adjacent to runways,

Right: Highway treaded tires tend to track foreign objects into aircraft operating areas creating hazards to jet engines.

Far Right: Nondirectional design tires of the type specified for tactical vehicles.



taxiways, ramps and hangar aprons. And when these tires reach the hard, smooth surfaces of aircraft operating areas these objects dislodge, endangering safe jet aircraft operation. By making the switch back to open tread (tractor) type tires the station noted a substantial decrease in FOD.

It was recommended that this practice be adopted Navywide. While problems regarding incorporation of such a requirement such as this are recognized, the end result in FOD prevention is considered to be ample justification. It is noteworthy, at this point, to mention how automobile tires got around to replacing the tractor type tire. Several parts catalogs for GSE list tire sizes without specifying type and state "buy locally." Local purchases are usually from the lowest bidder. See Box for Mil Spec requirements. A buck is saved by the motor pool but the price elsewhere may be high. In all probability, the case cited cost us more than all that which was saved.

It is significant that this FOD cause came to light through the observation of the Aviation Safety Officer's enlisted committee—reason enough for all aviation safety councils/committees to include FOD prevention as permanent agenda item.

Mil Spec for GSE Tires

Pertinent excerpts from Mil-T-1259C, the military specification for pneumatic tires for mounting on ground vehicles for tactical* military use are quoted as follows: "Tread design, **except those of highway design,** (bold ours) shall be nondirectional design." An example of such a design is depicted in the photo upper right.

"Highway tread shall be of commercial design." (photo upper left)

"Tires covered by this specification are intended primarily for mounting on tactical trucks, truck-tractors, trailers, semi-trailers and similar wheeled vehicles used by the U.S. Armed Forces."

This specification has been approved by the Department of Defense and is mandatory for use by the Departments of the Army, the Navy, and the Air Force.

***Tactical:** Motor transportation organizations fall into two classes, tactical and administrative.

Tactical vehicle:

1. Any vehicle designed for field requirements in combat or tactical operations, or for training personnel for such operations.

2. In restricted usage: A ground vehicle for use in such operations.

—USAF Dictionary

Brass Nut Mixup

A cracked brass self-locking nut and other brass nuts were recently found securing the transmission plate assembly of an Army UH-1E. While brass nuts of this type are rarely used in Navy aircraft, these nuts are in the Federal Supply system. If such a mixup can happen to the Army it could happen to the Navy—particularly in areas such as Vietnam where like aircraft are being operated and maintained.

It is impossible to tell the steel nuts from brass nuts by looking at them, as steel nuts are completely coated (threads and all) with a brass colored protective coating. Use of a magnet will quickly differentiate steel from brass nuts.

Supply bins that are not properly maintained and marked could account for this dangerous mixup. Also, mechanics who carry mixed assortments of brass and steel nuts in their tool boxes can contribute to such a hazard. As the Army notes—this type Murphy is color blind!

Gyro Handling

HIGH gyro removal rate can often be directly related to rough or improper handling. Gyros are delicate instruments and cannot withstand the shock of being dropped, jarred or struck by other pieces of equipment.

To preclude damage to the gyro, it should be transported to and from the aircraft in its original shipping container. When this procedure is impractical, the gyros should be hand-carried with special care.

Gyros should never be removed while they are running or spinning down. A gyro normally operates between 20,000 to 24,000 rpm and takes 15 or more minutes to run down. If a gyro is removed while it is running and if it is tilted more than 90 degrees, it will develop a gimbal lock. The gimbal will tumble and start to spin. If gimbal lock occurs while the gyro is turning, the gimbal may spin fast enough to damage the gimbal bearings.

Even though a gyro has malfunctioned and is being removed from the aircraft, the gyro must be handled with the same respect due a new one. It is easy to think of a gyro that has malfunctioned as one destined for the scrap pile. This is not so. It can probably be fixed. It is therefore very important that proper handling procedures also be employed during removal.

Gyro handling techniques are summarized as follows:

- Keep the gyro in the original shipping container as long as possible or provide a well padded, shock-absorbent container for transporting the gyro.
- Wait at least 15 minutes after removing electrical power from the aircraft and/or gyro before removing gyro. Do not remove a gyro while it is running.
- Lift gyro from the base and carry in an upright position. *Do not* lift the gyro by the wire pigtails.
- Handle the gyro with care at all times and avoid subjecting it to shock or vibration.

Whadesay?

MISUNDERSTOOD communications in cockpits are legend—some end in hairy incidents—some in tragic accidents. Most served to emphasize the need for clear, concise, standardized terminology.

On the ground, communications among mechanics involve a much broader range and the possibility of misunderstanding is much greater—but the consequences tend to be less impressive. Here's an exception:

A rated technician changed a cockpit instrument with the help of a striker. Upon removing the indicator the AT handed the screws to the striker telling him to "put them in the indicator holes." The AT then left for the shop. The striker understood the instructions as "put them in the intake holes." So, he removed the engine intake duct cover, put the screws in the intake duct and replaced the cover. Before the new indicator was replaced, a turnup was ordered. FOD to the engine was substantial as you've probably guessed.

So you don't misunderstand—the striker was no run-of-the-mill type—he had completed nearly four years of college towards a degree in electrical engineering.—Whadyousay?

Specialize, But . . .

DO you know your job? You do? Fine . . . but is that enough? So you are thoroughly familiar with your particular field. You've been to school to learn the basic system and you know all the components, their location, their operation; you even have memorized the part numbers. You are the best man around in your field. You are a specialist in an age of specialization! But wait a minute, can't you overdo this a bit? Does being a specialist mean that you ignore completely all other fields?

If for instance your field is hydraulics and you understand the aircraft hydraulic system completely; wouldn't it help to also know a little electrical theory, since many hydraulic components are electrically controlled? Or if you are an electrician and your responsibility ends at the plug, should your knowledge end there also? Wouldn't it help in troubleshooting to know what happens after power gets there?

This is the age of specialization and the modern jet has several complex systems, each of which requires a specialist. But these systems are integrated completely; one depends on the other. Therefore they cannot be fully separated for troubleshooting or repair purposes. There are overlapping areas that are questionable as far as responsibility goes where a little integrated knowledge would pay big dividends in improved maintenance.

So take the time to learn a little about the other man's job. Ask him a question or two. Pick up a book now and then. And pass on a few facts about your job.

Be a specialist, that's what is needed. But be able to "Communicate" with other specialists in their own language. It'll make a difference.

—Delta Tech Review

It's the Little Things

MAINTENANCE types of F-4s know that many inflight control problems are extremely difficult to troubleshoot because of the aircraft's complex system of augmentation, artificial feel and various other hydraulic components.

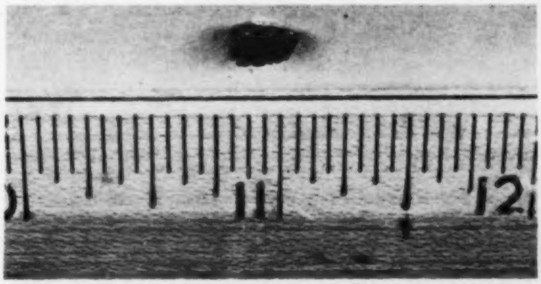
Here's a lesson learned the hard way which should be useful to others:

Pilot's Report—10-14 "Stabilator Trim shows 4 units nose up when other aircraft in formation show ½ unit nose up."
Fix—"Checked bellows system and engage and disconnect StabAug system; also checked fuel system." (12 man-hours)

Pilot's Report—10-16 "Takes full nose-up trim for level flight. Stick has little feel at low speeds."
Fix—"Ran autopilot check and replaced pitch trim actuator. Reserviced damper." (42 man-hours)

Pilot's Report—10-18 "Trim problem still present."
Fix—"Removed a piece of non-skid material from venturi assembly. (PN 5400010100-5) in ram air line to bellows." (3 man-hours)

—VF-84



Non-skid material lodged in venturi rotated and acted as a butterfly valve. Ground application of air to the ram air pickup is not a positive check for partial blockage of system.

Mobile Crystal Ball Discovers C-130 Electronics Ailments

IF a television repairman told you that a part in your set would soon become faulty and another part would fail, you probably would wonder skeptically if he had a crystal ball.

Actually, he is not trying to give you a line—he has the necessary test equipment to diagnose your set's ailments.

For the 32 C-130E *Hercules* of Naval Air Transport Wing, Pacific (NATWP), "crystal ball" reading is a part of their electronics maintenance program. In the Avionics Division of VR-8, the maintenance squadron for NATWP, the crystal ball is a shop-made $10,000 integrated electronics cart.

When used by an experienced technician, the cart can be used to predict and locate probable weak spots and impending failures in any one of the 23 electronics systems of the huge cargo transports without removing the sensitive equipment from the aircraft.

The cart, which can be powered by the aircraft electrical system, was designed by Chief Aviation Electronics Technician David T. Cudia for use in

500-hour Aircraft Periodic Maintenance Checks.

The cart was designed because it is easier to fix a discrepancy on a piece of gear than it is after it's completely broken down. He noted that 30 percent of the equipment checked during a periodic check failed operationally before the next 500-hour inspection. Bench checks revealed that 80 percent of all VHF radios were not up to minimum performance levels, and that necessary repairs were minor and amounted to weak tubes and tuning adjustments.

By bringing the cart to the aircraft instead of removing and bench-checking the electronics systems the aircraft can be released for operational commitments in a much shorter time.

The first check using the portable test cart resulted in the aircraft having a 100 percent communication/navigation reliability performance. A second test was made during a quality control inspection following an IRAN (Inspect, Repair As Necessary) inspection by the Lockheed factory at Marietta, Ga. The quality control test revealed four systems to be operating below minimum performance standards and the Marker Beacon Receiver to be completely inoperative.

None of these discrepancies were discovered in flight.

"We know," said Chief Cudia, "that the reliability of the electronics systems will improve greatly once utilization becomes standard practice."

Chief Cudia built the cart as a pilot unit to sell the concept of a mobile check cart. He would like to see integrated test equipment incorporated into an all-weather vehicle. "This vehicle would enable us to instigate an outstanding quality assurance program. We could verify discrepancies on the flight line which would eliminate costly hit or miss troubleshooting. A lot of the equipment is changed that is unnecessary. It would also assure a high quality of unscheduled maintenance performed on aircraft by testing, in the aircraft, repairs to electronics systems."

A similarly equipped vehicle, according to Chief Cudia, would work for any aircraft, not just the C-130s.

The only problem facing the Chief now is a need to get more men qualified to use the cart. This would mean having a man qualified in every one of the aircraft's electronics systems.

"We are convinced," he continued, "that the reliability of the electronics systems would be unsurpassed throughout the Military Airlift Command if we can procure the necessary equipment and are allowed to put this program into effect."

Warning!

Metal can, left, is approved flammable liquid container. Plastic container, right, is hazardous!

DON'T use plastic containers for flammable liquids! The National Fire Protection Association warns that flammable liquids are being stored in polyethylene plastic containers which were designed for water, bleaches, fruit juices, tea, milk and such liquids. Unfortunately, some manufacturers of these containers are advertising their use for all liquids, including gasoline and other flammables.

These containers are from one to five gallons in size. Some of the five-gallon containers are equipped with plastic spigots at the bottom, and are used in hospitals and laboratories. The NFPA explains that the so-called "fire-retardant" polystyrene and polyurethane plastics can become potential torches; and reputable manufacturers, as well as the Society of the Plastic Industry, have expressed their concern about the potential fire hazards of these plastic containers.

If the fire danger warnings don't impress you, remember that you're also likely to have mysterious malfunctions in your car or outboard carburetors if the gas is stored in the plastic containers for very long periods. The fuels can melt and mix with the

plastics, producing goop that your carb can't drink! And, while this is going on, the container walls get thinner and thinner. Then, when the fuel finally seeps out onto the back floor of your car or in the bow of your outboard, you have a real fine fire a-building.

So, be warned also that colorful replicas of the famous GI metal cans of WW II are being made from polyethylene, and other containers from other "fire-retardant, impermeable" plastics. Again, these blow-molded units are made for carrying water, juices, and such liquids, and should not be used as emergency gasoline cans.

Remember that gasoline will permeate some of these plastics at temperatures as low as 140°F. Temperatures in the trunk of a car, or in the covered bow of an outboard runabout, can easily reach that figure and higher on a hot summer day . . . and cause a fire.

If you happen to get safely through the summer with one of the hazards, you'll still be facing trouble; they are subject to rupture, especially during cold weather.

Approved metal containers don't cost so very much, and will allow you to comply with ICC regulations and Navy directives. There are too many other ways to get hurt; so why carry one of these booby-traps along with you?

—Adapted from USAF "Maintenance"

Fueling Radio-Equipped GSE

RADIOS on ground service motorized equipment should be turned OFF during fueling of the vehicle to eliminate the inadvertent operation of the transmitter.

With radio ON, high RF energy is entrained in the chassis and arcing of high intensity is possible.

If flammable vapors are present, an explosion and fire would ensue.

Turn radios OFF during fueling!

Driverless—Repairless

WHEN a CPO noted a driverless tow mule moving toward a closed hangar door he quickly shut the engine down and stopped the vehicle short of hitting the door. He noted the gear shift NEUTRAL button was in the proper position and the hand brake was set.

Investigation revealed the hand brake was not functioning and further, the vehicle could not be started by line men. The vehicle had been started by a Public Works mechanic who had been called for assistance. After starting the vehicle he left it unattended with engine running. There was enough drag in the vehicle's transmission to propel the unit.

The reporting unit directed that:

- No vehicle be left unattended with the engine running.
- Electric power units utilizing the vehicle's engine to run the the power unit will have the rear wheels chocked when the engine is running.
- Faulty equipment will be downed immediately for repairs.

—NAS Atlanta

No Conflict

ANY endeavor as complex as aviation maintenance presents its followers with seeming contradictions that sometimes puzzle and confuse. We are told, for example, that a mechanic should have initiative and ingenuity, that he should be able to think for himself. But at the same time he is required to follow instructions, "obey orders."

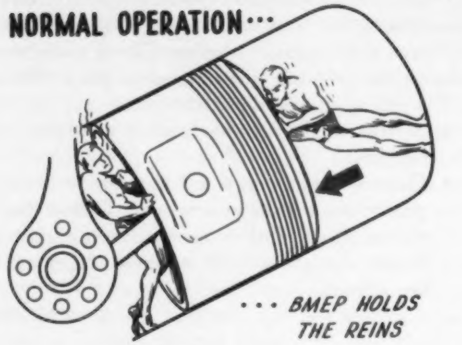
In most cases the instructions or orders or established procedures are explicit and unmistakable. They make no allowance for experience or judgment, afford no place for individual ideas. And so, it might be asked, if one must follow like a sheep and do exactly as he is told, what about initiative and ingenuity?

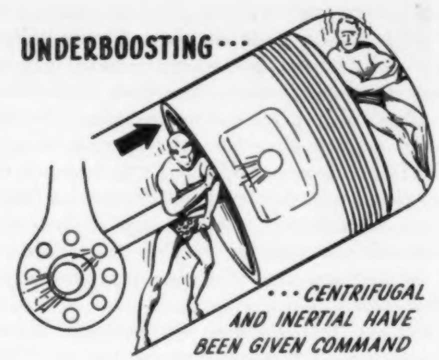
Actually there is no conflict.

Each procedure was established to achieve the greatest possible degree of reliability and safety. It represents opinion based on the facts known at the time. The best and quickest way to test it is for everyone to follow it exactly. If it works, well and good, if it doesn't, that fact will be evident. There is nothing sheeplike in pursuing such a course. In fact, it is the approach of the research scientist.

Of course, it is quite possible that the established procedure can be improved. This is the place for initiative and ingenuity and individual thinking. If you have a better idea submit it as quickly as possible. Don't just decide that the present procedure is wrong and do things in your own way. Get your idea out where it can be examined. If it is good it will be accepted. Even if topside doesn't buy it you will have increased your capabilities and improved your position through the experience.

In our business the willingness to follow instructions ranks equally with the ability to think. Cultivate them both. *—FSF Aviation Mechanics Bulletin*





Give The Boss A Break

Underboosting occurs when the combustion pressures do not equal the centrifugal and inertial forces generated by the crank shaft speed.

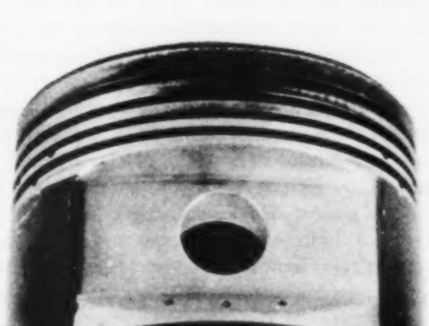
In other words, the gas and Oh Two and sparks that do all the work in the combustion chamber are not as powerful as usual because you have selected a reduced power setting with a constant or increased RPM. These power goodies do not resist the up-stroke of the piston with the usual vigor; hence the piston tends to really travel outbound, relatively unopposed, until kershtop?!;:?

The piston is halted in its journey by the limits of throw of the connecting rod with a very reduced assist from the low combustion pressures. The piston reverses its direction of travel and commences the downstroke. Guess what absorbs the shock of that sudden stoppage! That's affirm, Fosdick! The shock is absorbed by the piston rod, pin and piston boss. The rod and pin are made of pretty tough metal and may hack the shock. The piston boss is made of a softer metal and suffers most of the pain and strain and fatigue of the underboost.

When underboosting occurs often enough and long enough the piston boss fails and the engine soon follows suit.

The immediate cure for all this pain and strain in the boss area is to avoid underboosting! "Great!" you say. "How am I supposed to get from altitude to touchdown in my A-1, T-28, C-117, *Stoof?*" A good question!

Obviously, we can't have everyone make a power-on Split S to a landing (it's tough on the Super *Stoof's* roofs), but we can anticipate our altitude changes and start 'em earlier, carrying a higher MAP. Descents don't necessarily have to be made with increased RPM. The prop should go forward at the 180 or when *needed*, not eleventeen miles out. Avoiding "Hot" breaks in prop types will avoid the throttle back, prop redlined, brakes down configuration coming through the "90."



Piston pin boss cracking due to underboosting

True, there isn't much you can do but throttle back and start down hill when you are complying with instrument clearances and on GCAs, so you may have to underboost occasionally. The engine manufacturers realize that operational requirements dictate an underboosting now and then. They are now manufacturing pistons with improved structural strength in the boss area. It is going to be awhile before fleet users are equipped with the improved pistons, however, so we have to live with the status quo temporarily. We can relieve the problem by anticipating our descents, avoiding "Hot" breaks and giving the Boss a break.

—Hot Dope Sheet

MURPHY'S LAW*

A-4 Murphy

An A-4 was griped for a unsafe nose gear indication. The aircraft was towed into the hangar for a dropcheck. A jack was placed under the nose and the nose gear raised free of the deck. At this time the electricians were informed that the aircraft was ready to be dropchecked. Hydraulic and electrical power were then applied and a man entered the cockpit. The PO in charge of the dropcheck then asked for the gear indication, and a down-and-locked signal was given by the man in the cockpit. The petty officer then looked at the main mounts and observed two red flags from the main gear safety pins. The nose gear pin was removed and the order given to raise the gear handle. When the handle was raised the nose gear and starboard main mount started to retract allowing the starboard wing tip to contact the deck. Damage: Starboard aileron wrinkled and bent; skin on starboard wing tip outboard of wing fuel cell wrinkled; outboard aileron hinge starboard wing broken. Hydraulic and electrical power was immediately secured and the duty officer was notified of the accident.

In this case the main landing gear locking pin was placed in the starboard drag link bolt vice the overcenter lock. Improper placement of the safety pin was possible because of the installation of an old style drag link bolt which will accept the locking pin. Douglas Aircraft Company engineering order A2443783 of 11 July 1957 recognized this Murphy and, in order to prevent insertion of the pin in the wrong hole, changed the lightening hole in the drag link bolt from $\frac{1}{2}$-inch diameter to 5/16-inch. Use of those bolts previously manufactured with a $\frac{1}{2}$-inch hole was, however, still permitted. The primary cause of this accident was permitting the cycling of the landing gear with only a nosejack and the main gear restrained. The secondary cause was inserting the landing gear safety pin in the drag link bolt hole instead of the overcenter lock.

The CO of the reporting squadron commented: Murphy can be a tough customer. Just when you're certain he's gone for good, he strikes again. The combination of conditions which existed in order for this accident to occur is truly phenomenal. First, a particular type of drag link bolt, which hasn't been manufactured since July 1957 was installed, then the main landing gear locking pin was inserted in the wrong hole, and after this combination of circumstances an improper dropcheck procedure was performed. It is certain that the lesson learned which prompted the Douglas order was a bitter one. It has been years since the A-4 had been plagued with insertion of the gear locking pin in the drag link bolt. From all appearances, this situation was corrected when the engineering order reduced the diameter of the lightening hole from $\frac{1}{2}$-inch to 5/16-inch making it impossible to insert the safety pin in this hole. At the time of this accident no procedure had been established to check for the possibility of an old bolt being used. In our lack of foresight, we were not alone.

As a result of this accident, the command took the following action:

- The drag link bolts in all aircraft have been checked to determine if the gear locking pin can be inserted.
- Plane captains and maintenance personnel have been instructed to take particular care to insure that gear and external store pins are inserted in the proper holes.
- Reemphasized the importance of all maintenance personnel adhering to the prescribed maintenance procedures as set forth in the HMI.

*** If an aircraft part can be installed incorrectly, someone will install it that way!**

Letters

PK-2 Survival Kit

NAS Corpus Christi—It has come to my attention that training squadrons flying the TS-2A aircraft in the Corpus Christi area are removing the PK-2 survival kit (raft and equipment package) from their aircraft. In addition to creating a potentially dangerous situation, in view of the fact that at least 50 percent of syllabus flying is done overwater up to 50 miles at sea, it would appear that the kit removal is in violation of the NATOPS flight manual for the TS-2A aircraft. . .

Permit me to quote from the NATOPS manual:

1. Concerning configuration, page 1-93: "Each seat is suitable for use with a back-type parachute and a type PK-2 pararaft kit."

2. Concerning the ditching checklist for pilot, copilot, No. 3 operator, and No. 4 operator: "9. Take PK-2 raft—Canteen—(Time Permitting)."

3. The bailout checklist does not specifically mention the PK-2 kit, but it would naturally go with the crewman because it is strapped to the bottom of the parachute harness.

The prevailing opinion in the local area concerning the PK-2 kit seems to be that the one Mk-IV raft carried in the roof of the aircraft is quite sufficient for all four members of the crew. This may well be, *if* the crew does not bail out, *if* the raft is released from its internally inaccessible compartment by one of the three or four available methods, and *if* the raft does not become punctured by jagged aircraft metal or for other reasons.

It may appear to some that this matter constitutes a tempest in a teapot, but one raft for four people doesn't look like too much insurance to me. After being an avid reader of APPROACH for five years, I have become thoroughly convinced that "Complacency Kills." I would hate to see complacency kill any people flying the TS-2A.

CONCERNED MOUSE

• We're with you. Any squadron contemplating a change of procedure which doesn't comply with NATOPS should request a waiver.

Spadron-Thirty Three Presents

NAS Quonset—I had duplicate copies of all APPROACH magazines for the past 11 years in my files collecting dust. I went through all issues and cut out all articles concerning A-1 aircraft. From these I assembled the most interesting articles into a 13 x 18 inch leather bound photo album and entitled it "'Spadron-Thirty Three Presents—Truth or Consequences."

ComFAir Quonset, NAS Quonset and the squadron coffee mess put up $31.23 to cover the cost of the book itself, the gold embossed lettering and the plastic inserts. The stand was made by Public Works.

We have the album installed in the squadron readyroom for handy browsing.

In addition to being an attractive addition to our readyroom, it is a source of excellent safety/accident prevention information in handy form. It took a lot of work and lots of scrounging but I feel it was worth all the effort. I thought you might like to see some of the work that the Aviation Safety Center inspired me to undertake.

R. S. JACKSON, LCDR
ASO, VAW-33

• Looks like an excellent display. Thanks for the bouquet.

APPROACH welcomes letters from its readers. All letters should be signed though names will be withheld on request. Address: APPROACH Editor, U. S. Naval Aviation Safety Center, NAS Norfolk, Va. Views expressed are those of the writers and do not imply endorsement by the U. S. Naval Aviation Safety Center.

Pencil Flare Procurement

FPO, San Francisco—The Weekly Summary of Aircraft Accidents, 4-10 Oct 65, indicated that a Mk 79 Mod O pencil flare gun is scheduled for delivery to fleet squadrons. Squadron pencil flare guns and spare flares have heretofore been procured by open purchase. Can you please furnish me the required procurement data (FSN, unit of issue, price . . .), and specifications as well as details of any known automatic distribution of the gun and flares?

D. A. WOODARD
CO, VAP 61

• FSN: 1370-866-9788-X667 has been assigned to the Mk 79 Mod O Illumination Signal Kit.

Two hundred thousand kits are currently on procurement with scheduled delivery to begin in the fourth quarter of fiscal year 1966.

The unit of issue will be in kit form consisting of one flare launcher and a plastic bandolier with seven red flares. The exact cost per kit is not known but it is understood to be approximately $2 per kit.

It is recommended that MilStrip requisitions for this item be submitted through normal supply channels. Material should be available at coastal stock points in early summer.

Wants Warning on the Line

FPO New York—I suggest that at night any aircraft turning up on the flight line, by either pilot or ground crewmen, have all its lights turned ON (anticollision, markers and formation lights).

This might also be a good idea in the daytime, too. The problem is, at night, one cannot see the people, starting pods, removed intake screens and other ground handling equipment near the aircraft associated with an aircraft turnup.

Operators of ground support vehicles, such as trucks and tractors, find it hard to tell which aircraft is turning up while wearing Mickey Mouse ears.

D. J. PALESTINO, CPL
VMA-(AW)242

• Turning on rotating beacons or navigation lights, just before start and during ground turnup is general practice among airlines for the reasons you state. This would also be good practice for the military when lights are permitted.

NC-5 Plug-in Light?

Stoofville—On a foggy night four line crewmembers were on hand to launch five S-2Ds. I was on watch so I gave the linemen a hand by operating the NC-5 starting unit. After starting one aircraft I was signaled to the next one not realizing the NC-5 was still plugged in. As I moved the NC-5 to the next aircraft the cable was ripped out damaging the first aircraft as well as the NC-5.

This unfortunate accident suggests the need for a warning light on the dash of the NC-5 which would warn the operator that he is still plugged in. Thank you for your time.

NC-5 DRIVER

• A lot of GSE experts agree that such a device would be helpful in cases like this. A man needs every aid possible although the book says the hookup and disconnect of NC-5 starting units is a two-man operation. If an inexpensive prototype can be developed such a project may be worthwhile in view of the gradual replacement of NC-5s with NC-8s, -8As, -10s and -11s. Come on, you sparktricians—are you up to the challenge?

A-4 Fuel Tool

FPO New York—A locally fabricated tool has been most helpful in improving the reliability of fuel samples for the detection of fuel contamination. We pass it along for other A-4 squadrons.

Fuel samples are taken from the low point drain fittings of each fuel tank to check for impurities in the fuel. Because the heavier impurities will come out first, it is important that the first little bit of the fuel sample be captured in the bottle.

If a screwdriver is used to depress the drain plug, the first portion of the fuel sample usually runs down the screwdriver and is lost. Even a light wind will blow most of the fuel sample away from the bottle. In any case, if any of the sample gets away, the fuel check will not be valid.

This tool is a simple machined brass (nonsparking) tube. One end is fitted with a small protrusion that depresses the drain plug, the other end is necked down to fit into the sample bottle permitting complete funneling of the fuel into a sample bottle.

A fuel sample is taken by placing the tool into the bottle and then pressing the other end of the tool against the drain fitting. The tool is used to take samples from low point drains of the wing, fuselage and droptank fuel cells.

M. D. BARR, CDR
C.O. VA-64

Machined brass fuel drain tool, left, enables easy, reliable sampling, right.

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Our product is safety, our process is education and our profit is measured in the preservation of lives and equipment and increased mission readiness.

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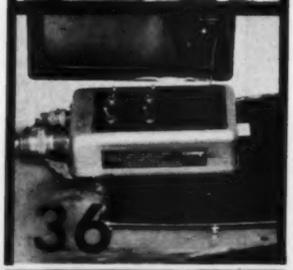

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A Word

Great men of all time are remembered in rhyme;
Brave men stand immortal in stone.
We never forget the valiant who met
Danger's challenge and faced it, alone.

The pilots who soar with thundering roar
Are saluted in musical lines.
But there's one motley crew, a forgotten few,
On whom glory's light seldom shines.

They spend their long nights in figuring drifts,
Settings, and headings and mach.
They wait for their bird to give them the word,
And pray that he doesn't break lock.

Their problems magnetic often give them a headache,
They slowly go blind watching squawks.
Their nightmarish sleeps run in twelve-second sweeps,
And they worship a little black box.

He runs the whole show, tells the birds where to go,
Selects headings and type of attack,
Watches for strangers and imminent dangers,
Guards their safety, and then brings them back.

A pilot's up there, somewhere in the air,
Pressure's dropping; he's out of the race.
The Controller's on call to get on the ball
And give him a steer for the base.

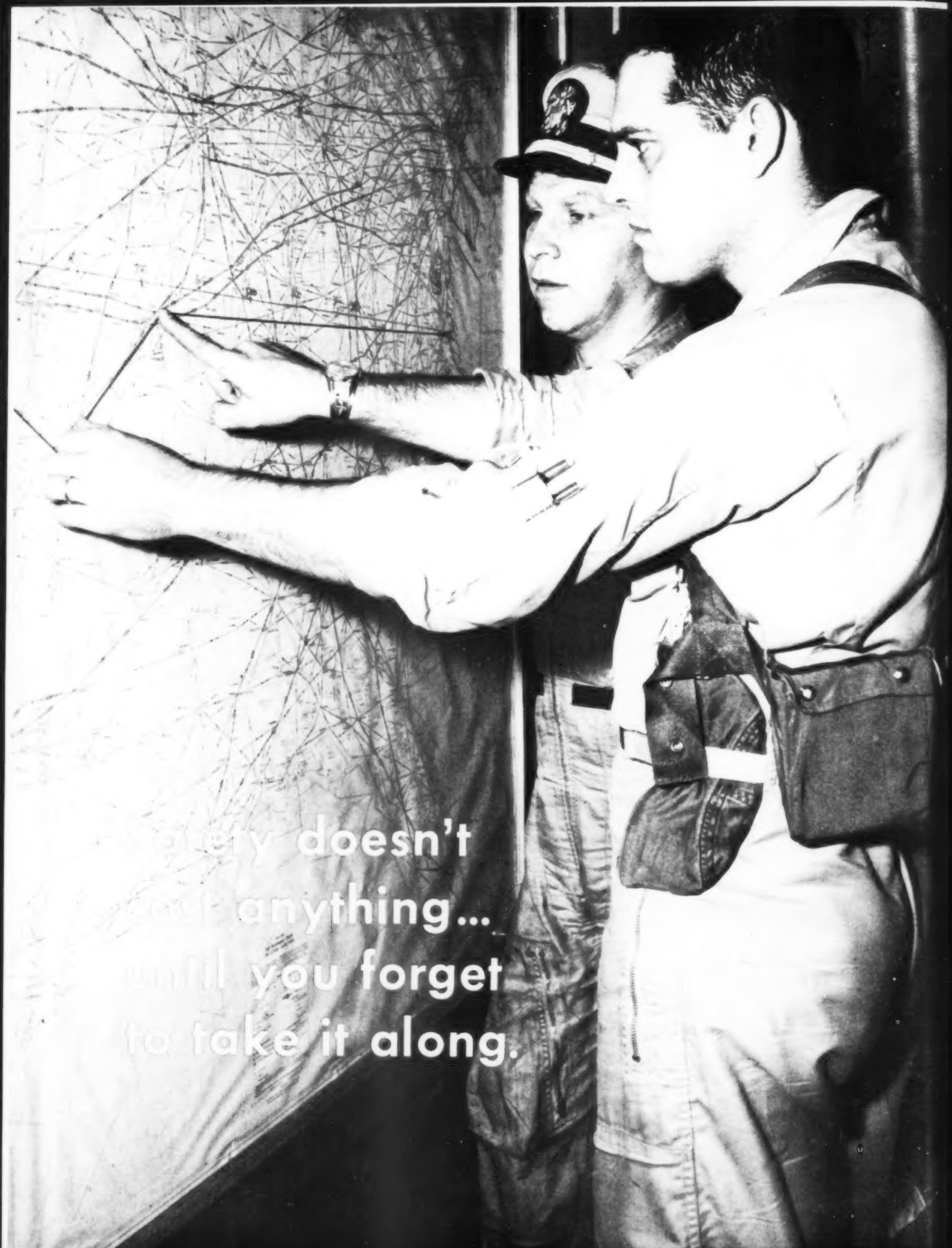
He'll moan and he'll groan, he'll cry into the phone
Until contact is made with his chicks.
But there's one lonesome call that he dreads most of all:
"Where are they? Get me a fix!"

When nothing is flying, he'll stand around lying,
Telling tall tales of his skill
At nighttime tomcatting and daytime combatting,
And how he moved in for the kill.

When the mission's all through, and the bleary-eyed crew
Adjourns to the Club for a snack,
The pilots come in and they say with a grin:
"Good show! We came right down the track."

This flying's a game that brings pilots great fame,
But just half the team flies, as a rule.
The other half's found away down on the ground—
The Controllers—a good one's a jewel.

—Adapted from Interceptor


doesn't
anything...
until you forget
to take it along.